Alternative Fuels Deployment Plan for I-81 and I-78 in Pennsylvania

FHWA APPLIED RESEARCH PILOT STUDY

U.S. Department of Transportation
Federal Highway Administration

pennsylvania
DEPARTMENT OF TRANSPORTATION

Michael Baker INTERNATIONAL 80 YEARS

PORTFOLIO ASSOCIATES INC.

TECHNICAL REPORT DOCUMENTATION PAGE

<table>
<tr><td colspan="2">1. Report No.</td><td>2. Government Accession No</td><td colspan="2">3. Recipient's Catalog No.</td></tr>
<tr><td colspan="3" rowspan="2">4. Title and Subtitle
Alternative Fuels Deployment Plan for I-81 and I-78 in Pennsylvania</td><td colspan="2">5. Report Date
July 2021</td></tr>
<tr><td colspan="2">6. Performing Organization Code:</td></tr>
<tr><td colspan="3">7. Author(s)
Ngani Ndimbie, Jackie Koons-Felion, Daniel Szekeres, Henry Felsman</td><td colspan="2">8. Performing Organization Report No.</td></tr>
<tr><td colspan="3" rowspan="2">9. Performing Organization Name and Address
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<tr><td colspan="2">11. Contract or Grant No.</td></tr>
<tr><td colspan="3" rowspan="2">12. Sponsoring Agency Name and Address
Federal Highway Administration
1200 New Jersey Avenue, SE
Washington, DC 20590</td><td colspan="2">13. Type of Report and Period Pilot
Final Report</td></tr>
<tr><td colspan="2">14. Sponsoring Agency Code</td></tr>
<tr><td colspan="5">15. Supplementary Notes</td></tr>
<tr><td colspan="5">16. Abstract
This pilot deployment plan documents the efforts conducted by the Pennsylvania Department of Transportation (PennDOT) and Pennsylvania Department of Environmental Protection (PA DEP) in planning for electric vehicle (EV) and compressed natural gas (CNG) infrastructure along the I-81/I-78 corridor in Pennsylvania. The deployment plan aims to identify the alternative fuel infrastructure that is needed for a "Ready" designation (under FHWA's Alternative Fuel Corridor program) along the corridor for both EV charging and CNG fueling and establish the steps PennDOT can take to facilitate implementation. The document is intended as a resource for future deployment plans and provides a recommended approach for outreach and coordination.</td></tr>
<tr><td colspan="2">17. Key Words
Alternative Fuel Corridors, Alternative Fuel Deployment Plan, Electric Vehicle Charging</td><td colspan="3">18. Distribution Statement
No restrictions.</td></tr>
<tr><td>19. Security Classif. (of this report)
Unclassified</td><td colspan="2">20. Security Classif. (of this page)
Unclassified</td><td>21. No. of Pages
96</td><td>22. Price
N/A</td></tr>
</table>

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized.

Acknowledgments

Funded by: The United States Department of Transportation (US DOT) Federal Highway Administration (FHWA)

Led by: Pennsylvania Department of Transportation (PennDOT)

Partners: Pennsylvania Department of Environmental Protection (PA DEP)

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About PennDOT: PennDOT oversees programs and policies affecting highways, urban and rural public transportation, airports, railroads, ports, and waterways. More than three-quarters of PennDOT's annual budget is invested in Pennsylvania's approximately 120,000 miles of state and local highways and 32,000 state and local bridges. PennDOT is directly responsible for nearly 40,000 miles of highway and roughly 25,400 bridges, a system first established in 1911.

Roughly 7,200 of PennDOT's complement of nearly 11,375 employees are engaged in the maintenance, restoration, and expansion of the state highway system. They work in central headquarters in Harrisburg and 11 engineering districts, with facilities in all 67 counties.

PennDOT also administers the state's 11.8 million vehicle registrations and 10.3 million driver's licenses and IDs, and oversees safety and emission inspection programs.

pennsylvania
DEPARTMENT OF TRANSPORTATION

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An Overview of the Alternative Fuels Deployment Plan for the I-81/I-78 PA Corridor

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Executive Summary

Since 2016, the Federal Highway Administration (FHWA) has been supporting the expansion of a national network of alternative fuel infrastructure along national highway system corridors through the Alternative Fuel Corridors (AFC) program. Corridors are designated "Ready" if there is sufficient infrastructure to support long-distance travel or "Pending" if there is not.

In 2019, FHWA launched a limited, applied research funding opportunity to develop AFC Deployment Plans. The Pennsylvania Department of Transportation (PennDOT) was one of just five transportation agencies selected nationwide. The purpose of the PennDOT Deployment Plan is to develop a strategy for filling gaps for electric vehicle (EV) fast-charging and compressed natural gas (CNG) infrastructure along the 166-mile I-81/I-78 PA corridor that will the satisfy FHWA criteria for a "Ready" designation. This includes ensuring that distances between stations be **within 50 miles for EV** and **within 150 miles for CNG**.

Goals for PennDOT's First Deployment Plan

As a pilot study – a first for PennDOT and among the first for FHWA – this Deployment Plan sets an example for how a transportation agency may plan for the build-out of alternative fuel infrastructure. Therefore, in addition to the main purpose of the study – upgrading the corridor to "Ready" for EV and CNG – PennDOT set the following goals, so that this document may be a resource for future plans conducted by state and regional planning agencies:

- Demonstrate a ***data-driven approach*** to prioritizing locations for new infrastructure
- Establish a ***role for a Department of Transportation (DOT) or Metropolitan Planning Organization (MPO)*** to play in planning and supporting future infrastructure
- Evaluate ***equitable methods for outreach*** to small and large businesses and to third-party infrastructure companies on priority locations and existing state funding programs
- Understand the current ***business models*** for station hosts and third-party infrastructure companies
- Collaborate with administers of existing state ***funding programs*** to explore opportunities to incorporate Deployment Plan priorities into program application processes

Key Corridor Statistics

Distance (Miles)
166 mi. total
89 as I-81, 77 as I-78
MD border to NJ border

Avg. Daily Traffic
100,000 in Urban Areas
35,000 in Rural Areas

Employment
590,000
(within 5 miles of corridor)

2020 EV-CNG Ownership
(for counties I-81/I-78 passes through)
16,208
Over 90% growth since 2018

Current AFC Infrastructure on I-81/I-78 Corridor

- ★ **3 EV stations qualifying under AFC program***
  - **I-81 Exit 52**
  - **I-78 Exit 51/53**
  - **I-78 Exit 67**
- ★ **3 CNG stations qualifying under AFC program**
  - **I-81 Exit 52**
  - **I-81 Exit 6/8**
  - **I-78 Exit 57**

***AFC EV stations must include both CHAdeMO and CCS connectors and be within 5 miles from the corridor**

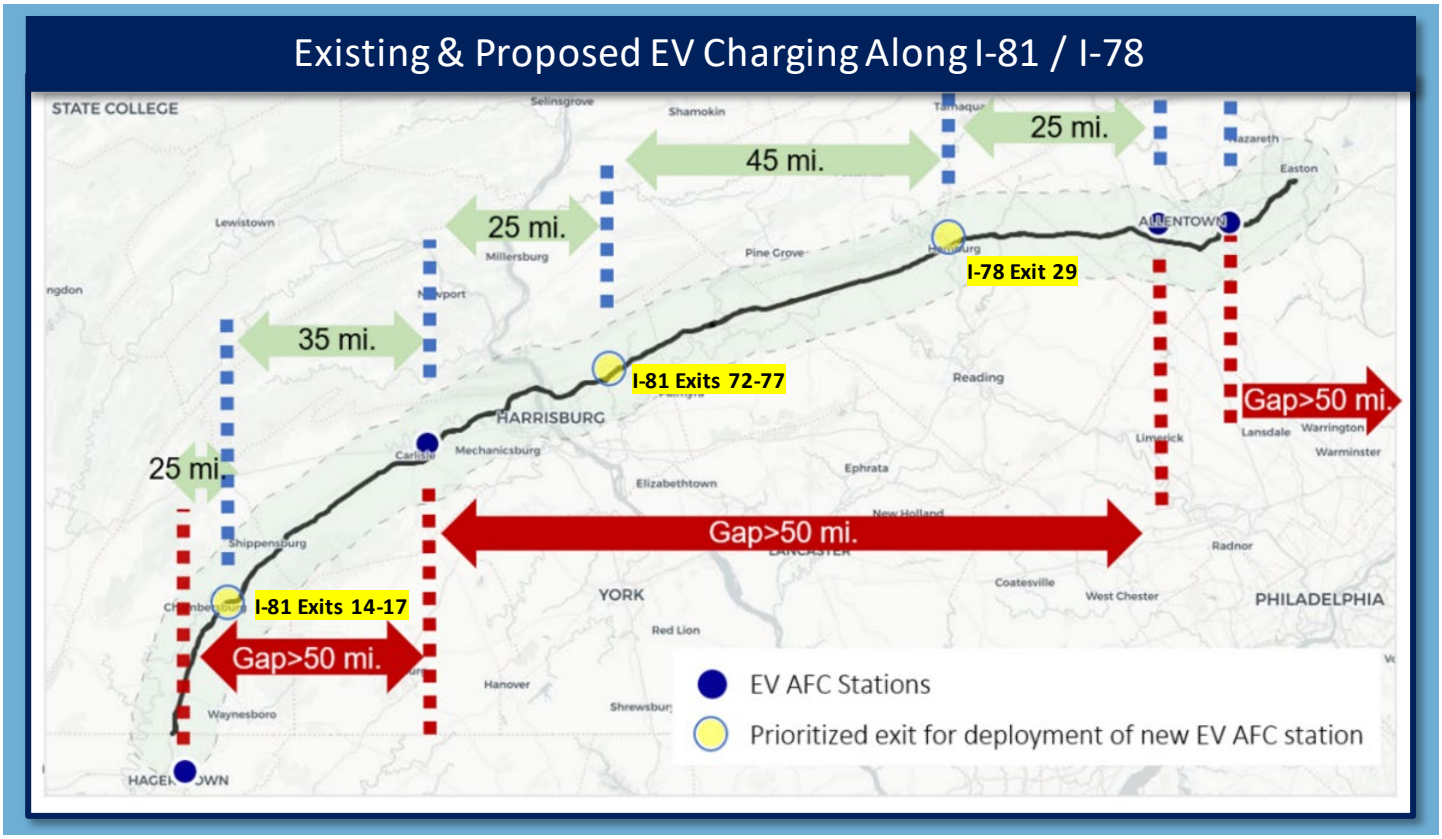
Key Findings

EV Charging

The map below shows the existing and proposed locations for new EV AFC-qualifying stations, as well as existing and proposed gaps on the I-81/I-78 corridor. A 5-mile buffer of the corridor is also shown, since for an EV station to quality under the AFC program, it must be within 5 miles of the corridor. The proposed locations for new EV AFC stations are:

1. **One new EV station at I-81 Exit 14, 16, or 17 in Chambersburg, PA**
2. **One new EV station at I-81 Exit 72 or 77 in Harrisburg, PA**
3. **One new EV station at I-78 Exit 29 in Hamburg, PA**

With new stations deployed at each of these three exit locations, the corridor will be eligible for an EV-"Ready" designation, from Hagerstown, MD to Bethlehem, PA – including 156 miles of the 166-mile PA corridor. The final gap, from Bethlehem, PA to the next station in Springfield, NJ, is unable to be filled with a new station in PA, since the Springfield, NJ station is greater than 50 miles away from the PA/NJ border. Coordination will New Jersey transportation planning agencies will be required to fill this gap.



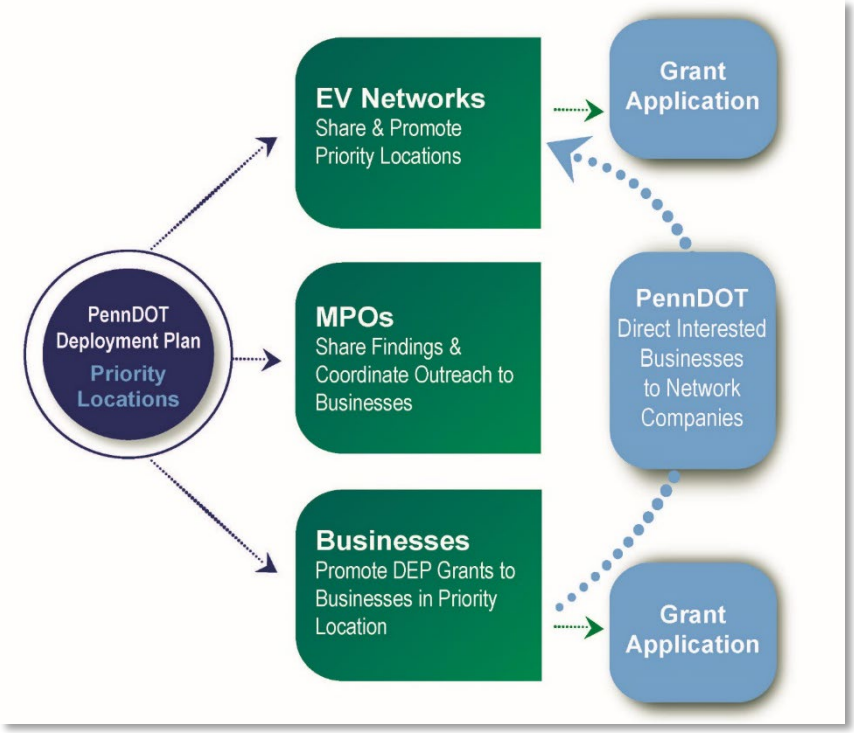
CNG Fueling

For CNG, the corridor already qualifies as "Ready" for 104 miles in Pennsylvania, from Carlisle, PA to the New Jersey border, and "Pending" for 52 miles, from Carlisle, PA to the Maryland border. Since the next CNG station south of Carlisle, PA, off I-81, is in Knoxville, TN, more than 500 miles away, and the "Pending" gap in PA is significantly less than the AFC maximum limit of 150 miles, the most strategic deployment of a new CNG station will be outside of the Commonwealth, requiring coordination with Maryland transportation planning agencies. Therefore, this Deployment Plan does not recommend locations for new CNG stations along the PA portion of the corridor at this time.

Outreach and Implementation Approach

The approach to implementing new stations involves sharing the priority locations identified in this Deployment Plan with key stakeholders responsible for station deployment – EV network companies, planning partners such as MPOs, and businesses – and promoting the existing state funding opportunities that are available. The primary funding opportunity for EV DC fast-charging station infrastructure is administered by the *Pennsylvania Department of Environmental Protection (PA DEP)*, as part of the *Driving PA Forward* program. The approach below was developed in collaboration with PA DEP with the goal of generating grant applications at priority locations when the 2021 cycle opens.

Approach to Facilitating Deployment of New Stations at Priority Locations



Next Steps

- **Continue Outreach to Businesses**
- **Maintain Discussions with EV Network Companies**
- **Work with PA DEP on Grant Opportunities**
- **Track Infrastructure Installations**
- **Share Lessons Learned with Planning Partners**

Lessons Learned

The following are lessons learned for each of the five Deployment Plan goals:

- Using a data-driven approach demonstrates to stakeholders that locations have been prioritized not merely to meet FHWA distance requirements, but also because of their potential economic viability.
- Roles that transportation agencies can play in facilitating station deployment include: identifying and sharing priority locations; promoting funding opportunities to EV charging companies and businesses at priority locations; and linking interested businesses with EV charging companies.
- Outreach with EV charging companies is critical, as they are the primary stakeholders responsible for implementation.
- Understanding EV station business models – both from the perspective of the site owner and the EV charging company – informs and enhances every aspect of the Deployment Plan.
- Collaboration with administers of funding programs is critical, as this is the strongest incentive the Commonwealth has that can facilitate the deployment of new AFC infrastructure.

Introduction

Study Purpose, Background, and Process

- Purpose
- The FHWA Alternative Fuel Corridors (AFC) Program
- Alternative Fuel Deployment Plans
- Corridor Background
- Planning Process
- Lead Agency & Jurisdiction

Introduction

Purpose

One of the most promising developments in the global effort to combat climate change is the increased availability and affordability of alternative fuel sources for transportation purposes, such as electricity and compressed natural gas (CNG). In the United States, the number of electric vehicles (EVs) on the road reached 1 million in October 2018[1], with another 326,000 sold in 2019, or about 2% of the 17 million vehicles sold.[2] Projections from the International Energy Agency (IEA) have this share of U.S. annual EV sales increasing to 8% by 2030 if newly instituted policies are followed, or as high as 30% by 2030 if the goals of the IEA's Electric Vehicle Initiative are reached.[3] Meanwhile, natural gas powers 175,000 vehicles nationally and about 23 million worldwide.[4]

As the third-highest producer of electricity in the United States, the second-highest producer of natural gas,[5] and the second-highest producer of zero-emission nuclear energy, Pennsylvania is uniquely positioned among states to transform its transportation sector while leveraging its local assets. With this Alternative Fuels Deployment Plan for I-81 and I-78, the Pennsylvania Department of Transportation (PennDOT) continues its commitment to reducing carbon emissions in the transportation sector and facilitating the build-out of alternative fuel infrastructure. The Deployment Plan identifies electric vehicle (EV) charging and compressed natural gas (CNG) fueling infrastructure needs along the I-81/I-78 PA corridor - which spans 166 miles from the Maryland border to the New Jersey border – and establishes a role for PennDOT in implementing projects at targeted locations in the years ahead.

The FHWA Alternative Fuel Corridors (AFC) Program

To facilitate the transition to alternative fuel use in the transportation sector, the public sector has begun to play an increasingly important role. This has included: expanding the use of alternative fuels for transportation fleets; addressing affordability barriers to ownership with incentives such as EV customer rebates; and addressing the concern of "range anxiety" among drivers with policies or grant programs that encourage the development of publicly accessible alternative fueling and charging infrastructure. In recent years, as EVs and other alternative fuel vehicles have become more affordable, increased attention has been given to ensuring there is sufficient infrastructure, to not only meet current demand, but also to instill confidence in prospective drivers of alternative fuel vehicles, for whom cost may become less of a factor in the future.

Since the Fixing America's Surface Transportation (FAST) Act was signed into law in December 2015, the Federal Highway Administration (FHWA) has been "establishing a national network of alternative fueling and charging infrastructure along national highway system corridors" through what is called the Alternative Fuel Corridors (AFC) program.[6] Per the FHWA website, the AFC program:

- "provides the opportunity for formal corridor designation on an annual basis;

[1] Edison Electric Institute, https://www.eei.org/resourcesandmedia/newsroom/Pages/Press%20Releases/EEI%20Celebrates%201%20Million%20Electric%20Vehicles%20on%20U-S-%20Roads.aspx
[2] Green Car Congress, 2020, https://www.greencarcongress.com/2020/03/20200310-fotw.html
[3] International Energy Agency, Global EV Outlook 2019, https://www.iea.org/reports/global-ev-outlook-2019
[4] U.S. Department of Energy, Alternative Fuels Data Center, https://afdc.energy.gov/vehicles/natural_gas.html
[5] U.S. Energy Information Administration, https://www.eia.gov/state/rankings/#/series/51
[6] Federal Highway Administration (FHWA), Alternative Fuel Corridors, https://www.fhwa.dot.gov/environment/alternative_fuel_corridors/

- "ensures that corridor designations are selected based on criteria that promote the 'build out' of a national network;
- "develops national signage and branding to help catalyze applicant and public interest;
- "encourages multi-State and regional cooperation and collaboration; and,
- "brings together a consortium of stakeholders including state agencies, utilities, alternative fuel providers, and car manufacturers to promote and advance alternative fuel corridor designations in conjunction with the Department of Energy."[7]

Over five Rounds from 2016-2020, the FHWA received 125 nominations from regional and state agencies in 49 states (plus D.C.) and designated portions of 134 interstates and 125 U.S. highways/state roads as alternative fuel corridors (AFCs). The AFC program covers five types of alternative fuels: 1) electric vehicle (EV) charging; 2) hydrogen; 3) propane; 4) compressed natural gas (CNG); and 5) liquefied natural gas (LNG). A corridor designated as "Ready" for a certain fuel type may be viewed by road users as having the public infrastructure required to support long-distance travel for that fuel type along that route. Corridors without sufficient infrastructure are designated "Pending."

Table 1 shows the AFC designation criteria for EV and CNG alternative fuel types.

TABLE 1: FHWA AFC Designation Criteria for EV and CNG

Alternative Fuel Type	Corridor "Ready"	Corridor "Pending"
EV Charging	Public DC Fast Charging **no greater than 50 miles** between one station/site and the next on corridor, and no greater than 5 miles off the highway. Additionally, each DC Fast Charging site should have both J1772 combo (CCS) and CHAdeMO connectors.	Public DC Fast Charging chargers separated by more than 50 miles. Location of station/site no greater than 5 miles off the highway.
CNG Fueling	Public fast fill, 3,600 psi CNG stations **no greater than 150 miles** between one station and the next on the corridor, and no greater than 5 miles off the highway.	Public, fast fill, 3,600 psi CNG stations separated by more than 150 miles. Location of station no greater than 5 miles off highway.

PennDOT has participated in the first four rounds of nominations. To date, more than 1,800 miles of Pennsylvania roadway have been designated as "Ready" or "Pending" alternative fuels corridors for at least one of the five fuel types.

[7] Ibid.

Alternative Fuel Deployment Plans

On July 3, 2019, the Federal Highway Administration (FHWA) released an applied research funding opportunity for transportation agencies to assist with planning for the deployment of alternative vehicle fueling and charging facilities along interstate corridors across the nation. These efforts focus on filling gaps and designating corridors as "Ready" as defined by the criteria established under the AFC program.

In October 2019, the FHWA awarded funding to PennDOT – working in collaboration with the Pennsylvania Department of Environmental Protection (PA DEP) and other local agencies – to assist with the planning for deployment of EV and CNG alternative fuel infrastructure along the I-81/I-78 corridor in Pennsylvania. This corridor runs 166 miles from the Maryland state line to the New Jersey state line, passing through the third and fourth most populous metropolitan statistical areas (MSAs) in the Commonwealth: Allentown-Bethlehem-Easton and Harrisburg-Carlisle.

This Deployment Plan aims to identify the alternative fuel infrastructure that is needed for a "Ready" designation along this corridor for both EV charging and CNG fueling, and establish the steps PennDOT can take to facilitate implementation.

Corridor Background

The selected focus corridor of this Deployment Plan is the I-81/I-78 corridor in Pennsylvania (**Figure 1**). It runs 166 miles in total: 89 miles as I-81 from the Maryland state line to the I-81/I-78 interchange; and for 77 miles as I-78 from the I-81/I-78 interchange to the New Jersey state line.

I-81, also called the *American Legion Memorial Highway*, is the longest north–south corridor in Pennsylvania, providing integral connections between urban areas, rural areas, and to other AFC-designated interstates, including the Pennsylvania Turnpike. The segment of I-81 that is the focus of this plan runs 89 miles, from the Maryland border to the I-81/I-78 interchange in Lebanon County, passing through the Capitol of Harrisburg, PA, where it carries around 100,000 vehicles per day including 20,000 trucks. North of the I-78 interchange, I-81 continues another 330 miles (143 miles in PA), providing a connection to I-80, passing through the Scranton-Wilkes-Barre metropolitan area in PA, and continuing through New York state, all the way to the Canadian border. South of the PA/MD border, I-81 runs another 450 miles, including 325 miles through central Virginia, before merging with I-40 about 30 minutes outside of Knoxville, TN.

I-78 runs 77 miles in Pennsylvania, from the I-81/I-78 interchange in Lebanon County to the Delaware River/New Jersey state line. The roadway is known as the *78th Division Highway* in Lebanon County, the *Chief Master Sergeant Richard L. Etchberger Memorial Highway* in Berks County, and the *Walter J. Dealtrey Memorial Highway* in Lehigh and Northampton counties. Passing through the growing Allentown-Bethlehem-Easton metropolitan area (Bethlehem is the fastest-growing city in the state), and with linkages to Harrisburg (I-81), Philadelphia (I-476), and New York City (I-78), it serves as an important commuting, transportation, and freight corridor, carrying around 100,000 vehicles per day, including between 15,000 and 19,000 trucks at its highest stretches around Allentown.

FIGURE 1: The I-81/I-78 PA Deployment Plan Focus Corridor

Deployment Plan Process and Framework

The following are the key steps in the process for developing the I-81/I-78 Deployment Plan. This document is intended as a "resource" for the development of future Deployment Plans at other locations. As such, future plans are anticipated to be more "streamlined" and will not require the extensive documentation provided in this report.

1. **Understanding the basics of EV and CNG business models**
   Among PennDOT's goals for this Deployment Plan was for it to be guided by a basic understanding of EV and CNG station business models. By ensuring that business model considerations inform key findings and conclusions of this plan, PennDOT intends for its priorities to align with and appeal to the potential site hosts and third-party infrastructure companies that are ultimately responsible for station implementation. This section provides an overview of EV charging levels, connector types, and station business models; CNG station business models; and key partners with which PennDOT will engage to facilitate the deployment of new stations along the I-81/I-78 PA corridor.

Understanding the Basics
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2. **Identification of key gaps and needs in EV and CNG infrastructure**
   The first analysis step was to identify corridor infrastructure gaps and the number of stations needed to upgrade the "Pending" portions of the corridor to "Ready". This section identifies the corridor's current EV and CNG "Ready" and "Pending" designations (any "Pending" portion of the corridor is considered a gap); provides details for existing EV and CNG stations, including the distance of the gaps between stations; and identifies the number of new stations needed along each "Pending" portion to upgrade the corridor to "Ready" for both EV and CNG.

Identifying Gaps & Needs
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3. **Identification of priority locations for EV and CNG infrastructure**
To identify the best locations for new infrastructure along the corridor, PennDOT conducted an analysis in two stages: 1) the prioritization of exit locations; and 2) at each prioritized exit location, the identification of specific sites that fit the business model for hosting new infrastructure. Several prioritization scenarios were developed that support the upgrade of the corridor from "Pending" to "Ready".

Identifying Priority Locations
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Exit Prioritization Results (Page 46)
Scenarios to Address Gaps (Pages 52, 56)

4. **Identification of existing state funding opportunities for new infrastructure**
After identifying priority locations for new infrastructure, the next step was to identify available incentives that PennDOT could leverage as tools for facilitating implementation. The primary incentive available is the Pennsylvania Department of Environmental Protection (PA DEP) *Driving PA Forward DC Fast Charging and Hydrogen Fueling Grant Program*.

Funding Opportunities
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5. **Outreach to infrastructure companies, planning partners, and businesses**
With input from PA DEP and insights from stakeholder outreach discussions with EV charging network companies, PennDOT created a framework for outreach to network companies, businesses and regional planning partners. This framework, which is based on generating grant applications from interested businesses at Deployment Plan priority locations, establishes a role for PennDOT to engage in ongoing outreach until the I-81/I-78 PA corridor becomes "Ready" for EV charging.

Outreach & Implementation
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Outreach Approach Figure 24 (Page 67)
Outreach Brochure Figure 25 (Page 70)
Business Survey Figure 26 (Page 71)

6. **Documentation of lessons learned and coordination on next steps**
As a pilot study, it was important for this Deployment Plan to document its lessons learned – not just for PennDOT, but for other transportation agencies planning for alternative fuels. This section also reiterates the study's key findings and charts out the next steps for PennDOT moving forward.

Conclusions & Lessons Learned
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Lead Agency & Jurisdiction

PennDOT is serving as the lead entity on this Deployment Plan. PennDOT will coordinate with other local, regional, and state agencies in working to plan for, develop, market, and fund alternative fuel infrastructure along the corridor.

TABLE 2: Contact for Lead Agency

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Email: nndimbie@pa.gov · Phone: 717-857-3209

Understanding the Basics

Learn More About EV Charging, CNG Fueling, Business Models, and Supporting Partners

- Electric Vehicle (EV) Charging
- Compressed Natural Gas (CNG) Fueling
- Key Partners for Implementing New Infrastructure

Understanding the Basics

Among PennDOT's goals for this Deployment Plan – its first and among the first nationwide – is for it to be guided by a basic understanding of EV and CNG station business models. This is especially important in identifying priority locations (see section *Identifying Priority Locations*), and developing an approach to outreach and implementation (see section *Outreach & Implementation*). By ensuring that business model considerations inform key sections of this plan, PennDOT intends for its priorities to align with and appeal to the potential site hosts and third-party infrastructure companies that are ultimately responsible for station implementation.

This section provides an overview of EV charging levels, connector types, and station business models; CNG station business models; and key partners with which PennDOT will engage to facilitate the deployment of new stations along the I-81/I-78 PA corridor.

Electric Vehicle (EV) Charging

EV Charging Levels

There are three levels of EV charging: Level 1 charging, which connects the vehicle into a standard wall outlet and is generally located in private residential parking locations; Level 2 charging, which can be public or private, and charges an EV about four times as fast as a Level 1 charger; and DC fast charging, which charges vehicles in about 30 minutes, and is the focus of the FHWA AFC program and this Deployment Plan. **Table 3** shows some key differences between Level 1, Level 2, and DC fast charging.

TABLE 3: EV Charging Levels – Key Differences[8]

Type	Range	Power	Use	Plug
Level 1	3.5 – 6.5 miles per 1 hour charging	1.4 kW; 120 V outlet (standard wall outlet)	· Residential parking location · E.g. in home garage overnight	 J1772  Tesla
Level 2	14 – 35 miles per 1 hour charging	7.2-19.2 kW; 208-240 V outlet	· While parked for several hours, including at residential locations · E.g. at workplace, hotel, shopping center, entertainment event, etc.	 J1772  Tesla
DC Fast (Level 3)	100 miles per 30 minutes charging*	50 kW-350kW; 480+ V outlet	· For a quick stop on a long-distance trip · For use by drivers who lack access to home-charging · E.g. fast-food restaurant, gas/convenience store, etc.	 CHAdeMO  CCS  Tesla

*Up to 150 miles or more per 20 minutes or charging for newer models (at 150 kW power)

Source: Clean Vehicle Rebate Project, Center for Sustainable Energy for the California Air Resources Board, 2021, https://cleanvehiclerebate.org/eng/ev/technology/fueling/electric; U.S. Department of Energy, Alternative Fuels Data Center, https://afdc.energy.gov/fuels/electricity_infrastructure.html

[8]The figures for range and power given in the table should be read as approximations, subject to fluctuations depending on the vehicle model and the charging infrastructure, as well as industry advancements that are increasing range and charging capacity on an ongoing basis.

DC Fast Charging Types

In addition to there being three different levels of EV charging, there are three different types of Level 3 DC fast charging, each using a different plug. The oldest DC fast connector type is CHAdeMO, which was developed in Japan and serves mostly Asian models. Many of its older chargers deliver power on the low end (at about 50kw) relative to the other DC fast types, but newer versions that were first made available for deployment in 2018 have been able to deliver power at much higher speeds including plans for 900kW charging in the future.[9] The Combined Charging System (CCS) connector type is more commonly used in European and American vehicles, and with a charging capacity of up to 350 kW, meaning it can provide up to seven times as many miles of range than a 50kW charger could in the same amount of time. The Tesla connector provides 250 kW of power; however, Tesla DC fast stations (or "Superchargers"; see **sidebar**) can only be used by Tesla vehicles and are therefore not considered public by FHWA for the purpose of designating corridors as "Ready" under the AFC program. Rather, FHWA requires that AFC-qualifying EV DC fast stations include at least one of each of the CHAdeMO and CCS connectors (must include both). Since Tesla vehicles are compatible with the CHAdeMO connector via an adapter (though the adapter works only one way; there is no adapter for non-Tesla models with CHAdeMO charging ports to use Tesla Superchargers), any station that hosts both CHAdeMO and CCS connector types will be able to provide charging power to any EV model, including a Tesla vehicle.

Tesla Superchargers

Despite not being recognized by the FHWA as pubic or counting toward AFC designations, Tesla DC Fast stations (or "Superchargers") play a crucial role in the EV ecosystem. The Tesla models they serve are far and away the highest-selling models nationwide, and it is no coincidence that they also possess the highest range capacities. Tesla Supercharger stations are also often higher in total power capacity when accounting for the number of plugs than most other EV AFC stations, including along the I-81/I-78 PA corridor. The three Tesla Supercharger stations along the corridor each contain eight chargers, or 24 total – significantly more than the 9 total DC Fast chargers (1-4 each) at the three EV AFC corridor stations combined.

TABLE 4: 2018-2019 Highest-Selling BEV Models, USA, by Connector Type

EV Models	US Sales		DC Fast Compatibility (US)			Range
	2019	2018	CHAdeMO	CCS	Tesla	
Tesla Model 3	154,836	139,730	X*		X	220-330 mi. (Long-Range (LR))
Tesla Model X	18,500	28,290	X*		X	258-328 mi. (LR)
Chevy Bolt	16,418	18,019		X		259 mi.
Tesla Model S	13,300	29,660	X*		X	287-373 mi. (LR)
Nissan Leaf	12,365	14,715	X			150-226 mi. (PLUS)
Audi e-tron	5,369	0		X		204 mi.
Volkswagen e-Golf	4,863	1,354		X		123 mi.
BMW i3	4,854	6,712		X		153 mi.
Other	14,208	2,178				

*Compatible with adapter

Sources: CleanTechnica, 2020, https://cleantechnica.com/2020/02/12/top-u-s-electric-vehicles-2019-vs-2018-best-sellers/; CNET, Road Show, https://www.cnet.com/roadshow/news/every-electric-car-ev-range-audi-chevy-tesla/

[9] CHAdeMO, 2021, https://www.chademo.com/technology/high-power/

Table 4 shows which DC fast types are used by each of the highest-selling battery electric vehicle (BEV) models nationally. Tesla model sales far outpace that of any other brand, underscoring the significance of Tesla Superchargers as essential EV infrastructure assets, despite not counting as EV AFC stations.

EV Charging Station Business Models

There are two main factors that distinguish EV charging business models: 1) *pricing*; and 2) the type of third-party *network* from which a site manager or owner may purchase equipment and/or partner with to operate the equipment. Often these factors are interdependent. For example, when the network company owns and operates the charging station, it sets the prices, incurs costs and collects revenue. In these instances, the business model for the site owner (not the network company, as network company business models vary in a different way) can be defined as "cost recovery", where any profit to the site comes not from EV charging, but from increased customer time and spending on site amenities, such as food. In other instances, when the property manager or owner owns/operates the charging equipment and sets the prices, there can be several other business models that take shape. To demonstrate this, **Table 5** shows how business models for site owners may be divided into six categories, based on combinations of pricing models and network partnerships. Note that these categories merely represent a general framework for understanding the various business models; in reality, business models are often flexible, negotiable and dynamic, and may fit into multiple categories.

TABLE 5: EV Charging Business Models for Site Managers/Owners[10]

		Pricing Model (from Site Owner Perspective)		
		Free charging	**Cost recovery**	**Profit-making**
Network Partnership Types	Network incurs costs/collects revenue	-	A	-
	Site owner incurs costs/collects revenue	B	C	D
	Cost/revenue sharing	-	E	F

These six business models for site owners or managers may be referred to and defined as follows:

A. Network-Owned-and-Operated Cost Recovery

The network incurs costs and collects revenue, while the site host business benefits by attracting new customers and enhancing their brand. This model is common for businesses hosting DC fast charging since it eliminates the expenses for businesses that would otherwise be needed to purchase, install, maintain, and operate the chargers. Rather than collect revenue from the chargers (that revenue is collected by the network company), the business benefits by increased customer attraction and spending on the core amenities provided by the business, such as food or retail. However, it is important to keep in mind that because the networks incur the risk of investment in this case, they will not just partner with any business that wants to employ this business model. On the contrary, the networks are much more selective in ensuring that they deploy a station in a

[10] Table 5 is an amalgamation and adaptation of several sources, including: for pricing models, https://pod-point.com/guides/business/ev-charging-business-models; and for network types, https://www.plugincars.com/ultimate-guide-electric-car-charging-networks-126530.html and https://49360769-d546-4026-9a30-327648e220cc.filesusr.com/ugd/7d5220_cce9147513ad4cd58895e135fde68bb7.pdf, combined with reviews of network websites for six networks with DC Fast charging infrastructure installed in Pennsylvania.

location that will be economically viable. ***EVgo*** and ***Electrify America*** are the two largest US networks that offer this model for AFC-qualifying CHAdeMO and CCS charging. In PA, EVgo's 18 partners for DC fast charging include Dunkin Donuts (7x), Rutter's (2x), and others; Electrify America's 10 PA partners include Sheetz (4x), Walmart (4x), and two shopping malls.[11] ***Blink***, which is known to offer site-owned and hybrid models, also employs this network-owned model in certain cases, including when applying for grant funding.

Figure 2 shows the Electrify America station located along the I-81/I-78 PA corridor at the Sheetz #191 in Carlisle, PA, off I-81 Exit 52.

FIGURE 2: Electrify America Station at Sheetz #191 in Carlisle, PA (I-81 Exit 52)

Source: Henry Felsman, Portfolio Associates

B. Site-Owned Free Charging

The property owner owns the chargers and offers free charging to attract customers. This model is more appropriate for Level 2 charging, which costs less to own/operate than DC fast chargers and retains customers for longer periods of time (such as at hotels).[12] For DC fast charging, this model is employed in PA most commonly at ***Non-Networked*** sites, such as auto dealerships, which offer DC fast charging to promote their EV models.

C. Site-Owned Cost Recovery

The property manager owns/operates the chargers and offers low prices to attract customers. This is appropriate for DC fast charging at locations where customers may spend 20 minutes to an hour, such as food or retail establishments. For the property owner, the revenue generated from the charger helps to recover the electricity costs including the high demand fees associated with DC fast charging.[13] Unlike the network-owned model, this also gives property managers the opportunity to

[11] U.S. Department of Energy, Alternative Fuels Data Center, 2020, https://afdc.energy.gov/data_download

[12] Pod Point, Business Models for Commercial Electric Vehicle Charging, https://pod-point.com/guides/business/ev-charging-business-models

[13] https://www.greenbiz.com/article/steep-utility-fees-are-killing-electric-car-charging-stations

offer locally competitive, dynamic prices.[14] ***ChargePoint*** is the largest US network of DC fast chargers that allows property managers to set prices and pursue this business model. ***Blink*** and ***Greenlots*** (purchased by Shell in 2019) are two other such networks.

D. Site-Owned Profit-Making

These have the same structures of the Site-Owned Cost Recovery models but with the property manager setting prices to make a direct profit from the chargers, rather than simply recovering the costs incurred to run the station. This is most appropriate for DC fast charging at locations where customers have limited to no other EV charging options, such as along interstates. In this case, managers must be careful about not charging too high a price. Users typically locate charging stations using mobile apps where they can leave comments and rate negative experiences.[15] ***ChargePoint, Blink,*** and ***Greenlots*** are networks compatible with this model.

E. Hybrid Cost Recovery

The property manager and partner network share costs and revenues with a low pricing structure meant to attract customers to the business establishment, generate cost-recovery charging revenue for the site (plus indirect profit-making revenue from increased customer on-site spending), and generate profit for the network. ***Blink*** has nine DC fast public charging stations in PA (including five at service plazas) and offers this option. With Blink, the revenue share is based on location, installation costs, term, and the contract agreement.[16] Another version of the hybrid is the subscription-based "as a service" model, offered by ***Blink***, ***ChargePoint,*** *and* ***Greenlots***. With these models, the network company installs and maintains ownership of the chargers, minimizing upfront costs for the site host while still allowing the site host to operate and collect revenue from the station as if they owned it. In return, the site host pays the network company an annual subscription fee which can be taken out of the revenue it collects.

F. Hybrid Profit-Making

These have the same structures of the Hybrid Cost Recovery models but with the site host's added expectation of generating direct profit from the chargers alone. In general, profit-making models are more suitable than cost recovery models at locations where there is less competition and high EV charging demand, such as targeted locations along interstates. As with Hybrid Cost Recovery, ***Blink***, ***ChargePoint,*** *and* ***Greenlots*** each offer some version of this model.

These six categories of business models provide a general framework for understanding the different reasons businesses choose to host charging stations on their properties, whether to attract new customers or to generate direct profit from charging. The categories also address the central role that partnering EV network companies play in determining the structure of how each model may be pursued.

For more details on the network companies that currently operate DC fast stations in PA, see Appendix **Table A** for the total number of EV stations operated by each network, and **Table B** for a comparison of various business model considerations.

[14] Pod Point, Business Models for Commercial Electric Vehicle Charging, https://pod-point.com/guides/business/ev-charging-business-models

[15] Fleet Carma, How to Choose the Best Locations for Public EV Charging Stations, https://www.fleetcarma.com/ev-charging-stations-choosing-best-locations/

[16] Blink, Electric Vehicle Charging Stations, https://49360769-d546-4026-9a30-327648e220cc.filesusr.com/ugd/7d5220_cce9147513ad4cd58895e135fde68bb7.pdf

Compressed Natural Gas (CNG) Fueling

There are several fundamental differences between the business models for hosting EV and CNG stations. One of them is the amount of time it takes for the vehicle to charge or fuel. Whereas EV stations are often hosted by commercial establishments that can employ a cost recovery model by profiting indirectly from increased customer attraction and on-site expenditure during the 20 to 30 minutes of charging, fast-fill CNG fueling takes only a couple of minutes and will not generate the same level of on-site customer spending on amenities. Another key difference is clientele. Whereas EVs are more commonly light-duty, individually-owned passenger vehicles, CNG vehicles are more commonly owned by a fleet that manages its own central refueling station, such as trucks (privately and/or publicly-owned), public buses, school buses, taxis, delivery vehicles, and utility vehicles.[17] For these reasons, it is not common for public fast-fill CNG stations to be hosted at individual commercial establishments, such as restaurants. Rather, they are more commonly installed either as standalone stations, at truck stops, or at fleet-owned properties. In the latter case, the cost recovery model can be employed, not by indirect revenue from increased customer expenditure on commercial amenities (as is often the case at EV stations) but by increased savings from the use of natural gas in their own vehicles.

The Drive Natural Gas Initiative, which includes members of the American Gas Association (AGA) and America's Natural Gas Alliance (ANGA), defines three business models for CNG station hosting. These business models are defined similarly by CNG Center using the same three general categories: [18]

1. **Fleet or End-User Ownership -** This model is employed by transit/transportation authorities, schools, waste management providers, private fleets, and others. In each case, the fleet owner may employ any one of the following four variations to this business model, depending on the structure of relationships between ownership, operation, gas transport, and gas sale:
    a. Owns and operates station, and contracts with utility for gas transport and sale.
    b. Owns station, contracts operations out to third party, and contracts with utility for gas transport and sale.
    c. Owns and operates station, contracts with utility for gas transport, and contracts with third party for gas sale.
    d. Owns station, contracts operations out to third party, contracts with utility for gas transport, and contracts with third party for gas sale.
2. **Local Distribution Company (LDC) Ownership –** In this case, the natural gas utility operates the CNG station. There are two ownership structures:
    a. Partial ownership (Hybrid) – Utility owns significant portion of facility, while commercial retailer owns fuel dispensers. Using a rate-based model, the utility recovers its costs via a "compression services" fee levied on its commercial co-owner, while the commercial entity recovers costs through unregulated rate fuel sale to customers.
    b. Full ownership – Utility owns and operates facility. Access may be public or be limited for fleet use.

[17] NGV America, https://www.ngvamerica.org/vehicles/
[18] American Gas Association, CNG Infrastructure Guide, https://www.aga.org/sites/default/files/sites/default/files/media/cng_infrastructure_guide.pdf; CNG Center, CNG Station Business Models, https://cngcenter.com/cng-station-business-models/

3. **Third-Party Ownership or Commercial Ownership (aka Commercial Operator)** – A commercial operator that is neither a fleet nor utility provider may also host a CNG station on a profit-making model.
    a. Own and operate – Commercial business owns and operates on profit-making, typically non-rate-based model.
    b. Operate only – In some cases, the property owner is not a fleet owner, utility owner, nor the CNG station operator.

One common theme across each of the CNG business models is partnerships. For example, Trillium, the leading CNG station developer in PA, partnered with PennDOT in 2016 to develop CNG stations for public-transit bus fleets at 29 sites across the state through a 20-year $84.5 million public-private partnership (P3) agreement. The P3 agreement is estimated to result in cost savings of more than $46 million while providing cleaner alternative fuel to more than 1,600 public buses in the state. The project also includes public access to CNG stations at select transit authority sites (five public stations at PA transit authority sites currently), as well as upgrades to/maintenance of existing stations. In a second example of synergetic partnerships, Trillium is part of the Love's Family of Companies, which includes the interstate exit service station Love's Travel Stops. Together, Trillium and Love's own 65 public CNG stations nationally. There are several Love's Travel Stops along the I-81/I-78 corridor, including at: I-81 Exit 52; I-81/I-78 Exit 90/1 (the I-81/I-78 interchange); I-78 Exit 23; and in Hagerstown, MD, two miles south of the PA/MD border. A new CNG station at this latter location in Hagerstown, MD would raise the eligibility of the I-81/I-78 PA corridor to "Ready" status for its entire 166-mile length.

In total, there are 88 CNG stations in Pennsylvania including 53 public and 35 private stations. Most public stations in PA (33 out of 53) are "standalone stations" as defined by the U.S. Department of Energy.[19] These stations resemble gas stations, though their ownership structures vary. **Figure 3** shows images of two standalone stations: one owned by the Cambria County Transit Authority and operated by Trillium; and one operated by GAIN Clean Fuel Clearfield County off I-80 adjacent to a Pacific Pride station. The second most common siting for CNG stations in PA is fleet garages. While most fleet garage stations are private, six are public, including five developed and operated by Trillium. For more information on the types of facilities where CNG stations are located in PA, see Appendix **Table C**.

FIGURE 3: Examples of CNG Public "Standalone Stations" in PA (Google Maps, Street View): Trillium – Cambria County Transit Authority (Left); GAIN Clean Fuel (Right)

Source: Google Maps, 2020

[19] U.S. Department of Energy, Alternative Fuels Data Center, 2020, https://afdc.energy.gov/data_download

Since alternative fuel infrastructure is a long-term investment, especially with respect to the build-out of increasingly comprehensive networks, it is important to recognize the fact that the business models employed by both EV and CNG station hosts will change over time. There are only 175,000 natural gas vehicles (NGVs) in the United States,[20] a low figure compared to the rest of the world and therefore one that has the potential to increase dramatically in the future. According to NGV Global, as of December 31, 2019, North America has the least amount of NGVs of any of the five major global regional markets, as shown in **Table 6**. This is not necessarily due to a lack of CNG stations as North America has one station for every 121 NGVs, which is the highest number of stations per NGV of the five markets. At the same time, an increase in the availability of public CNG stations, especially considering the size of the region and its low overall number of stations, could trigger economy-of-scale ripple effects where increased station availability at a certain point (perhaps with the build-out of the FHWA AFC network) could potentially inspire greater confidence in drivers and fleet operators to transition to NGVs.

TABLE 6: Natural Gas Vehicles (NGV) and Stations, by Global Regional Market

Region	NGVs	Stations	NGVs/Station
Asia-Pacific	20,473,673	20,275	1,010
Latin America	5,484,676	5,848	938
Europe	2,062,621	5,194	397
Africa	295,349	210	1,406
North America	224,500	1,856	121

Source: NGV Global, 2019, http://www.iangv.org/current-ngv-stats/

Key Partners for Implementing New Infrastructure

For this Deployment Plan to achieve its ultimate purpose – upgrading the I-81/I-78 PA corridor to "Ready" for EV and CNG – it must engage key partners that have the resources, ability, and authority to install and operate new stations. This includes: administers of existing funding programs for alternative fuel infrastructure; the alternative fuel infrastructure companies that develop and/or operate the stations; and the business or property owners of sites that could potentially host new infrastructure. To engage the latter category – local business communities – it will also be important to first engage PennDOT's planning partners, including metropolitan planning organizations (MPOs), for insight into the most appropriate methods for local-level outreach and communications within their jurisdictions. Utility companies will also have to be engaged early in the process if they offer incentives for alternative fuel infrastructure; or at minimum, later on in the process to ensure site capacity or determine what if any utility upgrades will be needed.

Pennsylvania Department of Environmental Protection (PA DEP)

To implement the new alternative fuel infrastructure in locations that are identified as priorities in this Deployment Plan, existing funding opportunities will have to be communicated and promoted to eligible program applicants, such as interested site hosts and infrastructure providers. For this reason, PennDOT has worked closely with the Pennsylvania Department of Environmental Protection (PA DEP) – the state agency that currently administers grant programs for alternative fuel infrastructure – in the development of this Deployment Plan, and will continue to do so throughout implementation. PA DEP

[20] Alternative Fuels Data Center, https://afdc.energy.gov/vehicles/natural_gas.html

has several grant programs for alternative fuel infrastructure, including: the Alternative Fuel Infrastructure Grant (AFIG) program; and the Driving PA Forward initiative, established under current Pennsylvania Governor Tom Wolf with the goal of permanently reducing NOx emissions by 27,000 tons.

For EV DC fast charging stations – the infrastructure priority identified in this Deployment Plan – the most relevant grant within these programs is the ***Driving PA Forward DC Fast Charging and Hydrogen Fueling Grant Program***. About $2 million per year has been awarded through this program. During the 2020 cycle, this grant offered awardees reimbursements of up to 70% of the total project cost, with a maximum award of $250,000. Since applications for the 2020 cycle were open during the development of this Deployment Plan (from July 2020 to February 2021), and the next cycle is anticipated to open in late spring/summer 2021, a key component of the stakeholder outreach approach for PennDOT was to communicate the availability of this funding to infrastructure companies that might be interested in applying.

One anticipated outcome of this Deployment Plan is ongoing collaboration with PA DEP to address Deployment Plan priorities in the grant application scoring criteria. During the 2020 cycle, PA DEP favored projects: 1) within one of the six major PA metropolitan statistical areas (MSAs) (in and around the cities of Philadelphia, Pittsburgh, Allentown, Harrisburg, Lancaster, and Scranton); 2) within 3 miles of an interstate; and 3) within 5 miles of an interstate and more than 25 miles from the nearest alternative fuel station of the same fuel type. Since PennDOT anticipates developing subsequent Deployment Plans on a regular basis for other "Pending" AFC corridors, there is an opportunity to work with PA DEP in updating the grant criteria for each future cycle to include the most up-to-date Deployment Plan priorities.

For more information on the Driving PA Forward DC Fast Charging and Hydrogen Fueling Grant Program and other funding opportunities, see section *Funding Opportunities*.

Alternative Fuel Infrastructure Companies

In addition to understanding the business models of EV and CNG stations from the site host perspective, understanding the business models of the third-party infrastructure companies is key to ensuring that any incentives – such as the PA DEP grant program identified above – generate the desired responses and outcomes. For example, for EV DC fast grant programs, it is not uncommon for EV network companies to take the lead in applying for that grant rather than the property owners that will host the stations, especially in instances when the EV network company is the owner and operator of the station. In other instances, the EV network company may still provide technical assistance on the application simply because the EV station is the EV company's area of expertise.

The PA DEP's Driving PA Forward DC Fast Charging and Hydrogen Fueling Grant Program requires that proposed stations be networked and favors applications that include "a letter of intent, memorandum of understanding, or signed site host agreement between the property owner and the proposed operator of the charging/fueling facility at time of application."[21] This means that, even in cases where the property owner has the technical capacity to fill out a competitive application, a network company would still have to be included in the process.

[21] PA DEP, DC Fast Charging and Hydrogen Fueling Grant Program Guidelines, 2020, http://www.depgis.state.pa.us/DrivingPAForward/pdfs/CY2020%20DCFC%20H2%20Program%20Guidelines.pdf

Another reason to engage the EV network companies is that there are existing relationships established in PA – between the networks and the commercial franchises that host their stations – that can be cultivated and reengaged to facilitate project implementation at a new location identified in this Deployment Plan. For example, all seven Dunkin' EV stations are networked by EVGo, all five Harley-Davidson EV stations are networked by ChargePoint, and all four Walmart EV stations are networked by Electrify America.[22] Therefore, if either of those three franchises have a site located at a priority exit location identified in this Deployment Plan, then there is a logical opportunity to engage the EV network with whom the franchise has an existing partnership to determine what next steps can be taken to further assess the economic viability of the site and the available funding opportunities. In other cases where there is no established relationship between a particular commercial franchise EV station host and particular EV charging network, there is an opportunity for PennDOT to play the role of matchmaker based on the analysis of business models and takeaways from outreach discussions conducted with the EV network companies that are included in this plan.

A very specific opportunity for EV DC fast includes coordinating Deployment Plan efforts with the *Zero Emissions Vehicle (ZEV) Investment Plan* developed by the EV network company Electrify America. Having developed more than 400 EV DC fast stations since its establishment in 2016, Electrify America has a national strategy for the build-out of its network that bears similarities to the FHWA's AFC program, prioritizing locations along key highway corridors, with the goal of stations being within 120 miles of one another, and 70 miles on key routes (as compared with the FHWA's AFC 50-mile threshold). In 2017, Electrify America published its National ZEV Investment Plan: Cycle 1.[23] In 2019, it published its National ZEV Investment Plan: Cycle 2.[24] For the northeast region, the Cycle 2 plan (currently being implemented) prioritized investment along I-78, from the existing Electrify America station in Carlisle, PA (I-81 Exit 52) to Newark, NJ; and along I-476/I-81, from Philadelphia, PA to Syracuse, NY. These two priority regional routes cross in Allentown, PA – the location of the Electrify America station at I-78 Exit 51/53 that opened in November 2020 and is identified in this plan. For Cycle 3, Electrify America solicited submissions during the summer of 2020. The type of comments requested included, among others: relevant information, data, or local plans/strategies that could help Electrify America determine its Cycle 3 investments; and specific site locations to be nominated. In August 2020, PennDOT submitted a comment to Electrify America that included an overview of the FHWA-PennDOT collaborative effort on Alternative Fuel Corridors, the existing gaps along the I-81/I-78 corridor, and the results of the exit prioritization and site analysis conducted as part of this Deployment Plan.

Businesses

Ultimately, implementing a new alternative fuel station requires the interest and participation of the site owner. For EV DC fast charging stations, this is typically a private business (though there are a few exceptions where chargers are located on public property). For PennDOT, this means engaging businesses by promoting existing grant opportunities offered by PA DEP and targeting such promotion towards businesses that are near exit locations prioritized in this Deployment Plan. As a first step, prior

[22] See **Table 19**: PA Properties Hosting EV DC Fast Infrastructure, by EV Network

[23] Electrify America, National ZEV Investment Plan: Cycle 1, 2017, https://www.electrifyamerica.com/assets/pdf/National%20ZEV%20Investment%20Plan.3100e374.pdf

[24] Electrify America, National ZEV Investment Plan: Cycle 2, 2019, https://www.electrifyamerica.com/assets/pdf/Cycle%202%20National%20ZEV%20Investment%20Plan%20-%20Public%20Version%20vF.50bb1fe0.pdf

to conducting any outreach directed at local businesses, PennDOT will coordinate with its regional and local planning partners for insight into following the appropriate channels of communication, from the state down to the local level.

Planning Partners

PennDOT's regional and local planning partners, such as metropolitan planning organizations (MPOs), counties, and municipalities are important sources of local insight on all interregional projects. For this Deployment Plan, PennDOT will continue to work with these planning agencies – especially those whose jurisdiction covers the priority locations identified (see following section, *Identifying Priority Locations*) – to discuss barriers to and opportunities for the implementation of new alternative fuel stations.

TABLE 7: All Exit Locations, by Municipality and County, I-81/I-78 PA Corridor

I-81			I-78		
Exit	**Municipality**	**County**	**Exit**	**Municipality**	**County**
1	Antrim Twp	Franklin	90/1	Union Twp	Lebanon
3	Antrim Twp	Franklin	6/8 †	Bethel Twp	Lebanon
5	Greencastle Borough	Franklin	10	Bethel Twp	Berks
10	Guilford Twp	Franklin	13	Bethel Twp	Berks
14	Chambersburg Borough	Franklin	15	Bethel Twp	Berks
16	Guilford Twp	Franklin	16	Bethel Twp	Berks
17	Chambersburg Borough	Franklin	17	Bethel Twp	Berks
20	Greene Twp	Franklin	19	Upper Tulpehocken Twp	Berks
24	Southampton Twp	Franklin	23	Upper Bern Twp	Berks
29	Shippensburg Twp	Cumberland	29	Tilden Twp	Berks
37	Penn Twp	Cumberland	30	Hamburg Borough	Berks
44	South Middleton Twp	Cumberland	35	Greenwich Twp	Berks
45	Carlisle Borough	Cumberland	40	Greenwich Twp	Berks
47	Carlisle Borough	Cumberland	45	Weisenberg Twp	Lehigh
48/49	South Middleton Twp	Cumberland	49	Upper Macungie Twp	Lehigh
52*†	Middlesex Twp	Cumberland	51/53*	Upper Macungie Twp	Lehigh
57	Silver Spring Twp	Cumberland	54	South Whitehall Twp	Lehigh
59	Hampden Twp	Cumberland	55	Salisbury Twp	Lehigh
61	East Pennsboro Twp	Cumberland	57†	Allentown City	Lehigh
65	East Pennsboro Twp	Cumberland	58/59	Allentown City	Lehigh
66	Susquehanna Twp	Dauphin	60	Upper Saucon Twp	Lehigh
67	Harrisburg City	Dauphin	67*	Bethlehem City	Northampton
69	Susquehanna Twp	Dauphin	71	Lower Saucon Twp	Northampton
70	Lower Paxton Twp	Dauphin	75	Williams Twp	Northampton
72	Lower Paxton Twp	Dauphin			
77	West Hanover Twp	Dauphin			
80	East Hanover Twp	Dauphin			
85	East Hanover Twp	Lebanon			
90/1	Union Twp	Lebanon			

*Includes existing EV AFC station

†Includes existing CNG AFC station

Table 7 shows the municipal and county jurisdiction for each exit along the focus corridor. Each exit represents an area where a potential AFC station may be deployed. Connecting each exit with its local authority is a key qualitative consideration, since development standards and permitting procedures for alternative fuel infrastructure can vary at the municipal level.

Table 8 shows the five MPOs and seven counties through which the I-81/I-78 corridor runs.

TABLE 8: Corridor MPOs and Counties

Route (Miles)	MPO	Corridor Counties*
I-81 (1-25)	Franklin County MPO (FCMPO)	Franklin
I-81 (26-80)	Harrisburg Area Transportation Study (HATS)	Cumberland, Dauphin
I-81 (81-89); I-78 (1-8)	Lebanon County MPO (LEBCO MPO)	Lebanon
I-78 (8-43)	Reading Area Transportation Study (RATS)	Berks
I-78 (44-77)	Lehigh Valley Planning Commission (LVPC)	Lehigh, Northampton

*Includes only counties through which I-81/I-78 PA corridor passes

Through the recommendations of the MPOs, PennDOT will also explore opportunities to establish contact with other partner organizations that could assist with implementation in the future, potentially as liaisons between PennDOT and local businesses interested in hosting alternative fuel stations. Such organizations may include Chambers of Commerce, Economic Development Corporations, and local business associations.

Utilities

The Pennsylvania Public Utility Commission (PUC) plays an important role in facilitating the development of alternative fuel infrastructure in the state. For EV charging, the PUC has adopted the policy that third-party EV charging stations are a service, and not considered only a resale of utility services. This policy – which each utility in PA now has codified into their tariffs – allows EV charging stations to offer dynamic rates with profit potential.

To implement an EV station, once a site is located, the property's utility provider would be contacted to do an interconnection analysis to determine if adequate power capacity exists, or if additional investments would be needed. The utility companies for the I-81/I-78 PA corridor are: Allegheny/West Penn Power Co. (Franklin County); PPL Utilities (the Harrisburg-Carlisle and Allentown-Bethlehem MSAs in parts of Cumberland, Dauphin, Lehigh, and Northampton Counties); and Metropolitan Edison Co. (primarily Lebanon and Berks Counties).

Identifying Gaps & Needs

An Identification of Gaps and Needs in Existing Alternative Fuel Corridor (AFC) Program-Qualifying Infrastructure

- Current AFC Designations
- Existing EV and CNG Infrastructure
- Identification of Gaps and Needs in AFC Infrastructure

Identifying Gaps & Needs in Existing AFC Infrastructure

Current AFC Designations

During the FHWA's Alternative Fuel Corridors (AFC) Round 3 in 2018, PennDOT successfully nominated segments of the I-81/I-78 PA corridor as "Ready" or "Pending" for EV and CNG based on the existing infrastructure at the time. As a reminder, AFC "Pending" corridors are defined as those with gaps of 50 miles or more between qualifying EV stations, and 150 miles between qualifying CNG stations.

For EV, the corridor is currently designated "Pending" in its entirety, though it is eligible for "Ready" status for the approximately 15-mile segment between the EV stations in Lehigh County (I-78 Exit 51/53 in Allentown, PA) and Northampton County (I-78 Exit 67 in Bethlehem, PA). For CNG, the corridor is currently: "Pending" for 52 miles, from the MD state line to the CNG station in Cumberland County (I-81 Exit 52 in Carlisle, PA); "Ready" for 94 miles, from the CNG station in Cumberland County to the next CNG station in Lehigh County (I-78 Exit 57 in Allentown, PA); and "Pending" for the final 20 miles of the corridor to the NJ state line, though eligible for a "Ready" designation, since the next CNG station in New Jersey is less than 150 miles away. **Table 9** shows the current EV and CNG designations for the I-81/I-78 PA corridor, based on the mile where the AFC designations change.

TABLE 9: Current AFC Designations, I-81/I-78 PA Corridor

<table>
<tr><th>Highway</th><th>Mile</th><th>Limits</th><th>EV Designation</th><th>CNG Designation</th></tr>
<tr><td rowspan="3">I-81</td><td>1</td><td>PA/MD state line</td><td rowspan="5">"Pending"</td><td>"Pending"</td></tr>
<tr><td>52</td><td>EV station in Cumberland County CNG station in Cumberland County</td><td rowspan="3">"Ready"</td></tr>
<tr><td>89</td><td rowspan="2">I-81/I-78 interchange in Lebanon County</td></tr>
<tr><td rowspan="5">I-78</td><td>1</td></tr>
<tr><td>51/53*</td><td>EV station in Allentown</td><td rowspan="2">"Pending"; "Ready"-Eligible</td></tr>
<tr><td>57</td><td>CNG station in Lehigh County</td><td rowspan="3">"Pending"; "Ready"-Eligible (w/ NJ station)</td></tr>
<tr><td>67</td><td>EV Station in Northampton County</td><td rowspan="2">"Pending"</td></tr>
<tr><td>77</td><td>PA/NJ state line</td></tr>
</table>

*Station accessible via Exit 51 EB or Exit 53 WB

Figures 4 and 5 show the EV and CNG "Ready" and "Pending" designations for the FHWA AFC nomination Rounds 1-3. The I-81/I-78 PA corridor is identified on each map, circled in red. From these maps, it is easy to see that the corridor occupies a central position within the state's AFC network, connecting several "Ready" interstates, including I-76 from Harrisburg to Philadelphia, and I-476 from Allentown to Philadelphia.

FIGURE 4: EV AFC Designations, I-81/I-78 and Other PA Corridors

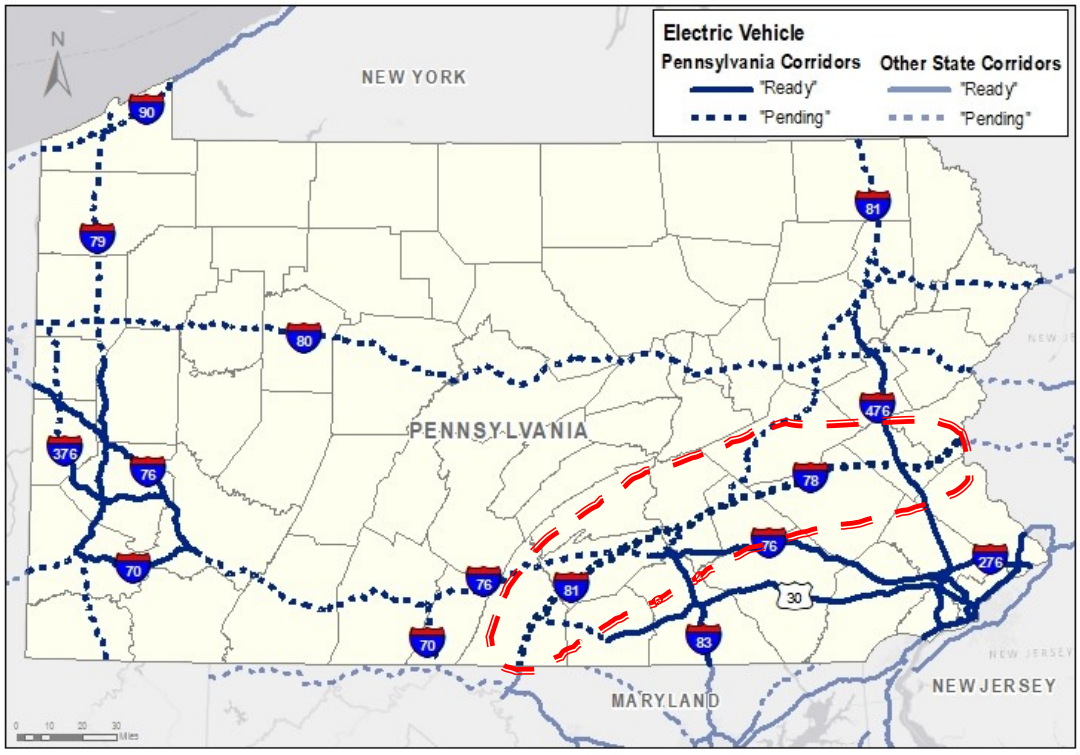
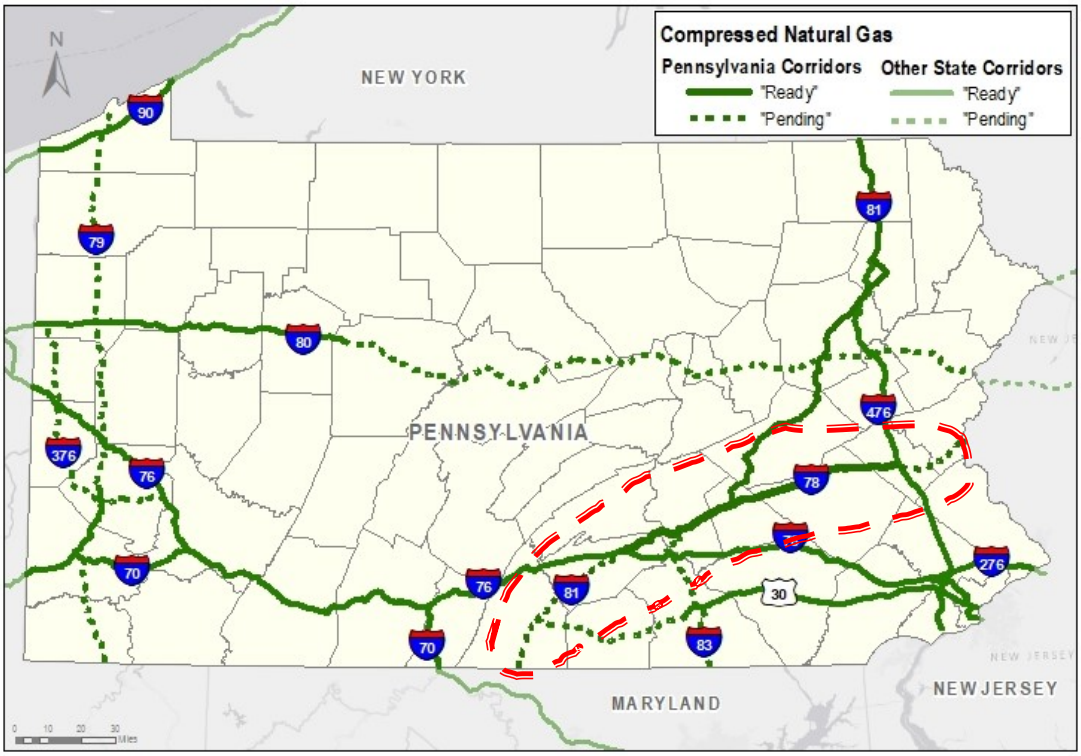


FIGURE 5: CNG AFC Designations, I-81/I-78 and Other PA Corridors



Existing EV and CNG Infrastructure

To begin comprehensively assessing EV and CNG infrastructure needs along the corridor, PennDOT collected information on all existing EV and CNG infrastructure. This inventory exercise goes beyond addressing the gaps between stations providing important details on station characteristics that also impact the alternative fuel user experience, such as the number of chargers at each EV station, the distance each station is from the highway, and the presence of non-AFC EV and CNG infrastructure (e.g. Tesla, EV Level 2, and non-public CNG stations).

Identifying Gaps and Needs:

Step 1:
Identify existing alternative fuel infrastructure in the corridor

Table 10 shows the number and type of EV and CNG stations along the corridor (within 5 miles), as compared with PA, the states that the corridor connects (MD and NJ), and the country. It is worth noting that PA has significantly less DC fast stations than MD, despite having twice the population. Some of this can be attributed to state policies: MD has a goal of having 200,000 zero-emission vehicles (ZEVs) deployed by 2020, and 300,000 ZEVs by 2025, as part of a multi-state ZEV program.[25] At the same time, PA has a relatively high number of CNG stations, compared to the states that the focus corridor connects, likely due to PA's high production of natural gas, 2nd to Texas among all states.

TABLE 10: Number of EV and CNG Stations, I-81/I-78 PA Corridor & Selected Geographies

Fuel	Station Type	I-81/I-78 PA Corridor	PA	MD	NJ	USA
EV	**Total**	60	554	656	392	25,017
	Level 2*	53	493	585	330	22,415
	DC Fast (all)*	9	81	360	87	3,544
	DC Fast (both CCS & CHAdeMO types)	3	32	73	31	1,868
CNG	**Total**	3	88	12	27	1,595
	Public	3	53	8	15	899
	Private	0	35	4	12	696

*Stations w/ both Level 2 and DC Fast are counted in both the Level 2 and DC Fast rows, but only counted once in the Total row.
Source: U.S. Department of Energy, Alternative Fuels Data Center, 2020, https://afdc.energy.gov/data_download

Existing AFC-Qualifying Infrastructure

Table 11 shows details for each of the corridor's AFC-qualifying EV and CNG stations. As a reminder, AFC-qualifying stations: 1) must be public; 2) must be within 5 miles of the interstate; and 3a) for EV, must have at least one CHAdeMO connector and at least one CCS connector; or 3b) for CNG, must be fast-fill 3600 psi. The table also shows the distances between AFC-qualifying stations, with the current AFC designation for each corridor segment indicated in green ("Ready"; less than 50 miles), orange ("Pending" but "Ready"-Eligible; less than 50 miles), or red ("Pending"; greater than 50 miles).

Figure 6 shows the three EV and three CNG stations that meet the FHWA's criteria for AFC infrastructure along the corridor. To illustrate that these stations are within the FHWA-required 5 miles of the corridor, a 5-mile buffer of the corridor is indicated on the map.

[25] Maryland Department of the Environment, https://mde.maryland.gov/programs/Air/MobileSources/Pages/ZEV.aspx

TABLE 11: Distance Between AFC-Qualifying Fueling Locations: I-81/ I-78 PA Corridor

EV AFC Stations
"Ready" Segment; "Ready"-Eligible Segment; "Pending" Segment

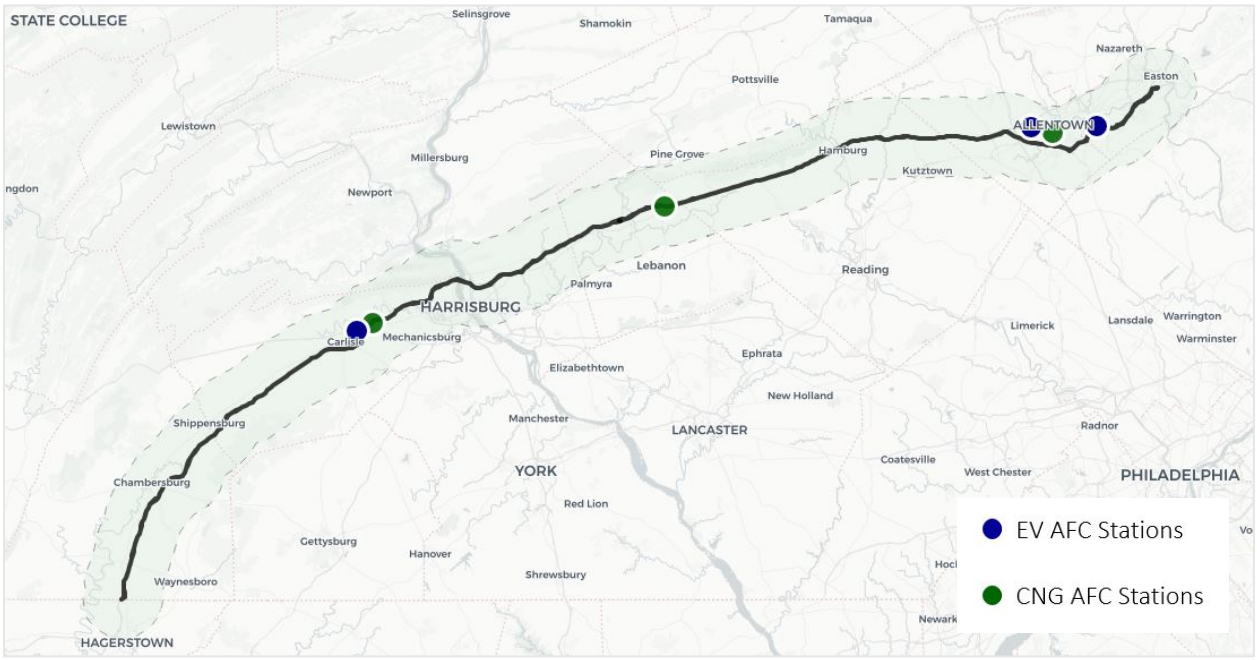
Owner	Exit	Address	Details	Distance from Near Exit	Distance to Next AFC Station
Sheetz #191	I-81 #47 NB #52 SB	1098 Harrisburg Pike Carlisle, PA 17013	**Outlets:** 4 **Connectors:** CHAdeMO, CCS **Network:** Electrify America	3.5 mi. #47 NB 2.5 mi. #52 SB	NB: 96 mi. SB: None in PA (50 mi. to PA/MD border) (60 mi. to AFC-qualifying station in Hagerstown, MD)
Brixmor Village West	I-78 #51/53	3100 Tilghman St. Allentown, PA 18104	**Outlets:** 4 **Connectors:** CHAdeMO, CCS **Network:** Electrify America	4 mi. #51 EB 2.5 mi. #53 WB	EB: 18 mi. WB: 96 mi.
Ben Franklin TechVentures, Lehigh University	I-78 #67	116 Research Drive Bethlehem, PA 18015	**Outlets:** 1 **Connectors:** CHAdeMO, CCS **Network:** Greenlots	3.5 mi.	NB: None in PA (14 mi. to PA/NJ border; 67 mi. to AFC-qualifying station in Springfield, NJ) WB: 18 mi.

CNG AFC Stations
"Ready" Segment; "Ready"-Eligible Segment; "Pending" Segment

Owner	Exit	Address	Details	Distance from Near Exit	Distance to Next AFC Station
Clean Energy Carlisle Flying J #708	I-81 #52	1501 Harrisburg Pike Carlisle, PA 17013	**Type:** Fast-fill **Pressure:** 3600 psi	< 1 mi.	NB: 44 mi. SB: None in Corridor (52 mi. to PA/MD border; 93 mi. to station off corridor via I-70 in Frederick, MD)
GAIN Clean Fuel	I-78 #6 EB #8 WB	725 Legionnaire Dr. Fredericksburg, PA 17026	**Type**: Fast-fill **Pressure:** 3600 psi	< 1 mi. #6 EB 2 mi. #8 WB	EB: 53 mi. WB: 44 mi.
Trillium – Lehigh and Northampton Transportation Authority	I-78 #57	1060 Lehigh St. Allentown, PA 18103	**Type**: Fast-fill **Pressure:** 3600 psi	2 mi.	EB: None in PA (22 mi. to PA/NJ border; 81 miles to AFC-qualifying station in Newark, NJ) WB: 53 mi.

Source: U.S. Department of Energy, Alternative Fuels Data Center, 2020, https://afdc.energy.gov/data_download

FIGURE 6: EV and CNG Alternative Fuel Corridor (AFC) Stations, I-81/I-78 PA Corridor (w/ 5-Mile Buffer)



Other EV Infrastructure

For EV, beyond the three AFC-qualifying stations, it is important to note that there is a variety of other types of EV stations along the corridor that constitute a large proportion of its alternative fuel infrastructure. Among the six non-AFC-qualifying DC fast locations within 5 miles of the corridor, three include only the CCS connector type (AFC-qualifying stations must provide both CHAdeMO and CCS connector types), and three are Tesla Superchargers, which are compatible only with Tesla models and therefore not considered publicly accessible by the FHWA.

Table 12 shows the details for each of the six non-AFC-qualifying EV DC fast stations on the corridor. Generally, these types of stations would be viewed as potential candidates for infrastructure upgrades that would qualify them as AFC stations. However, on the I-81/I-78 PA corridor, since these types of stations are located very close to existing EV AFC stations, upgrades to them alone would not be sufficient in filling the 50-plus mile distance gaps between stations that is required to upgrade the corridor to "Ready."

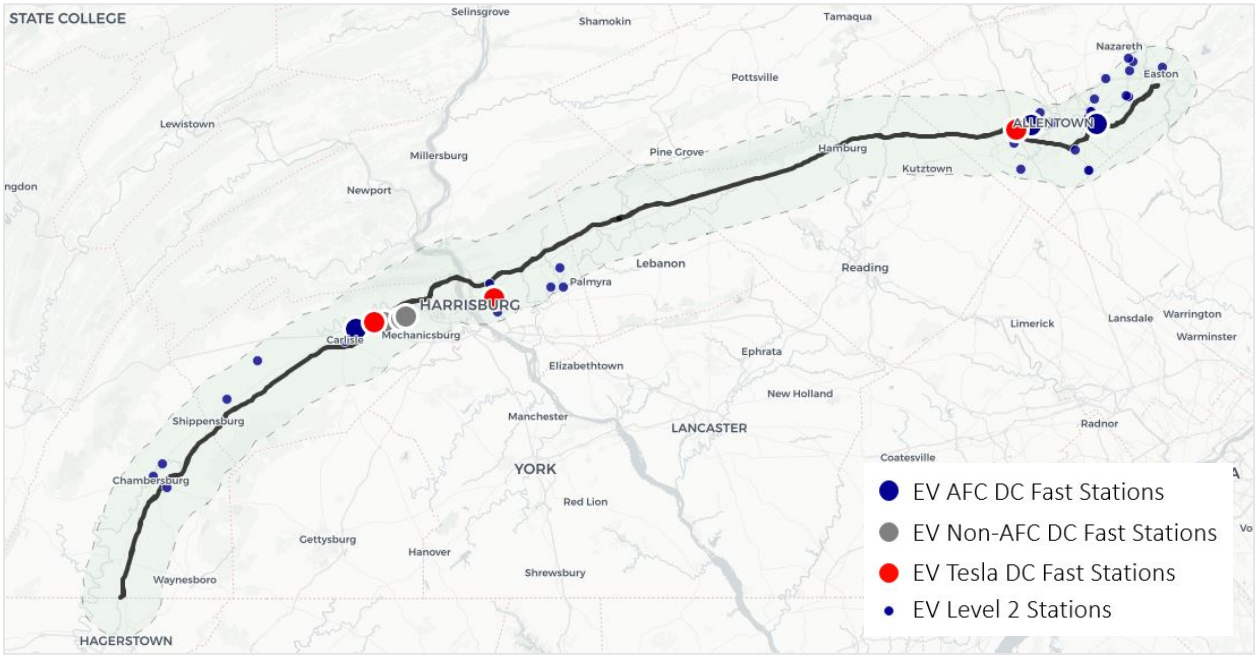
Figure 7 shows all 60 EV stations along the focus corridor, including: the three AFC-qualifying DC fast stations; the three DC fast stations with only CCS connector type; the three Tesla Superchargers; and 51 locations that offer no higher than Level 2 charging. While the AFC program does not count public Level 2 charging stations towards "Ready" designations, they play an important role in encouraging the more widespread adoption of EVs among drivers, especially those in metropolitan areas who may not be able to charge their vehicle at home. As indicated in the map, most of these public Level 2 charge locations are clustered in the Harrisburg-Carlisle and Allentown-Bethlehem-Easton metropolitan areas, with a gap of more than 60 miles between the eastern-most I-81 location in Hummelstown, PA and the western-most I-78 location in Allentown, PA. Nearly all of these stations are several miles off the interstate. See Appendix **Table D** for details of each of the 51 public EV Level 2 stations along the corridor.

TABLE 12: EV DC Fast Locations, Non-AFC Qualifying: I-81/I-78 PA Corridor

Owner	Exit	Address	Details	Distance from Near Exit	Non-Qualifying Factor
Sheetz – Tesla Supercharger	I-81 #52	1720 Harrisburg Pike Carlisle, PA 17015	**Outlets:** 8 **Connectors:** Tesla **Network:** Tesla	< 1 mi.	Station does not have CHAdeMO or CCS connector
Jaguar Land Rover Harrisburg	I-81 #52	7020 Carlisle Pike Carlisle, PA 17015	**Outlets:** 1 **Connectors:** CCS **Network:** ChargePoint	2 mi.	Station does not have CHAdeMO connector
Appalachian Harley-Davidson	I-81 #52 EB #57 WB	6695 Carlisle Pike Mechanicsburg, PA 17050	**Outlets:** 1 **Connectors:** CCS **Network:** ChargePoint	4.5 mi #52 EB 4 mi. #57 WB	Station does not have CHAdeMO connector
Porsche Mechanicsburg	I-81 #52 EB #57 WB	6629 Carlisle Pike Mechanicsburg, PA 17050	**Outlets:** 1 **Connectors:** CCS **Network:** ChargePoint	4.5 mi #52 EB 4 mi. #57 WB	Station does not have CHAdeMO connector
Union Square Shopping Centre – Tesla Supercharger	I-81 #70	3819 Union Deposit Rd Harrisburg, PA 17109	**Outlets:** 8 **Connectors:** Tesla **Network:** Tesla	3 mi.	Station does not have CHAdeMO or CCS connector
Tilghman Square Shopping Centre – Tesla Supercharger	I-78 #51 EB #53 WB	4680 Broadway Allentown, PA 18104	**Outlets:** 8 **Connectors:** Tesla **Network:** Tesla	2 mi #51 EB 2 mi. #53 WB	Station does not have CHAdeMO or CCS connector

Source: U.S. Department of Energy, Alternative Fuels Data Center, 2020, https://afdc.energy.gov/data_download

FIGURE 7: All EV Stations, I-81/I-78 PA Corridor



Identification of Gaps & Needs in AFC Infrastructure

Identifying Gaps and Needs:

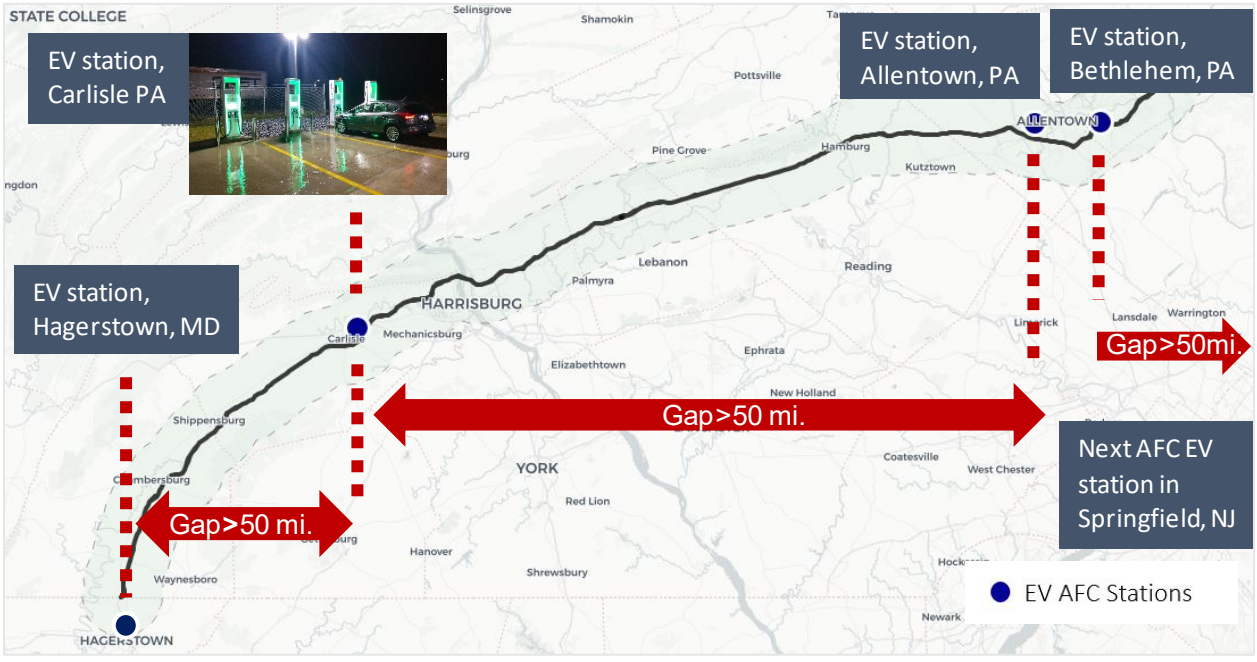
Step 2:
Identify and visualize the gaps where infrastructure is needed

Upon collecting information on each EV and CNG station along the corridor including distinguishing the AFC-qualifying stations from the non-AFC-qualifying stations, the next step was to identify "gaps" in EV and CNG AFC-qualifying infrastructure and the number of new AFC stations needed to fill each of them. Consistent with FHWA distance criteria for "Ready" and "Pending" AFC designations, this Deployment Plan defines "gaps" in AFC infrastructure as distances of greater than 50 miles between EV AFC stations and distances of greater than 150 miles between CNG AFC stations.

EV Gaps & Needs

Figure 8 shows the three EV AFC stations along the corridor and the gaps that exist between them. As indicated in the map, there are three AFC gaps along the corridor: 1) from the EV AFC station in Hagerstown, MD to the EV AFC station in Carlisle, PA; 2) from Carlisle, PA to the EV AFC station in Allentown, PA; and 3) from the EV AFC station in Bethlehem, PA to the next EV AFC station in Springfield, NJ. The first gap, from Hagerstown, MD to Carlisle, MD, is about 60 miles and can be filled with the deployment of ***one new station*** between them. The second gap, from Carlisle, PA to Allentown, PA, is about 95 miles. While it is possible that this gap could be filled with a single station, the location of this station would have very little flexibility since it would need to be within 50 miles of both the Carlisle and Allentown EV stations. In fact, the only locations where this station could be located is at I-78 Exits 6/8 and 10, rural areas with a limited number of businesses. For this reason, to maximize flexibility in prioritizing areas that are best suited to support a new EV station from a business model perspective, this Deployment Plan will develop a scenario that identifies locations for ***two new stations*** that in tandem would serve to fill this gap.

FIGURE 8: EV AFC Gaps in Corridor Infrastructure



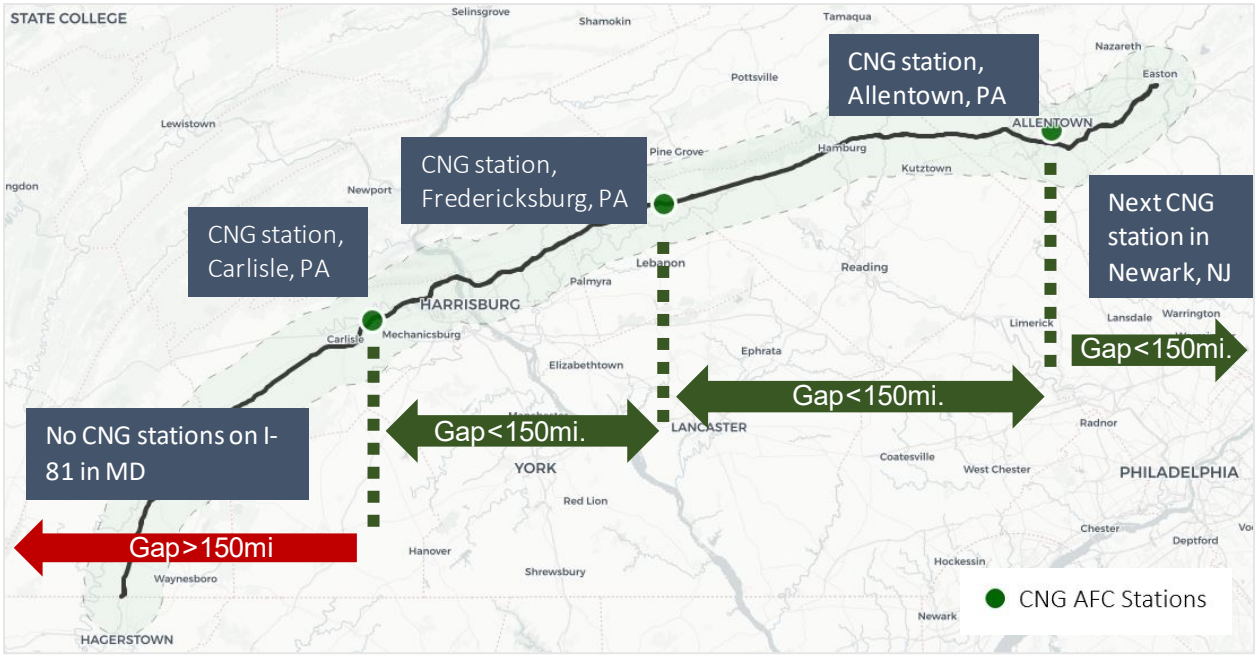
The third gap, from Bethlehem, PA to the next EV station in Springfield, NJ is 67 miles and can be filled with a single station. However, since it is only 14 miles to the PA/NJ state line, even if an EV station were deployed right on the PA/NJ border, a greater than 50-mile gap would still exist between this new station and the next one in Springfield, NJ. Therefore, the most efficient way to fill this gap would be for the new EV AFC station to be installed in NJ, about halfway between Bethlehem, PA and Springfield, NJ, with ***no new stations*** required in PA to fill this gap.

In addition to identifying gaps, it is also important to note that each of the three EV AFC stations along the corridor are several miles off the interstate. This makes them less than ideal for EV drivers who might expect to charge their vehicle right off the nearest exit. Since encouraging the more widespread adoption of EVs means, in part, ensuring the prospective EV driver experience will not be diminished, EV chargers should, when possible, be deployed in locations that are just as convenient to get to (i.e. just as close to the nearest exit) as gas stations. For this reason, this Deployment Plan also considers locations for EV AFC infrastructure in Carlisle, Allentown, and Bethlehem, PA, in addition to potential locations that merely fill the gap. PennDOT's goal for this Deployment Plan is not only to meet the minimum FHWA requirements for AFC designations, but also to recognize opportunities to strategically deploy infrastructure in a way that makes EV usage more attractive to drivers in PA – whether living, working, visiting, or just passing through – in both the short-term and long-term.

CNG Gaps & Needs

Figure 9 shows the three CNG AFC stations along the corridor. As indicated in the map, each of the three stations are separated by a gap that is within the FHWA-required distance of 150 miles, qualifying the corridor for a "Ready" designation from the Clean Energy in Carlisle, PA (I-81 Exit 52) to the Trillium in Allentown, PA (I-78 Exit 57; owned by the Lehigh and Northampton Transportation Authority (LANTA)). In 2018, PennDOT successfully nominated this 94-mile portion of the corridor as "Ready" for CNG.

FIGURE 9: CNG AFC Gaps in Corridor Infrastructure



East of the Trillium station in Allentown, PA, the next CNG AFC station is at the Newark International Airport in Newark, NJ, 81 miles away. Since this is within the FHWA-required distance of 150 miles, this portion of I-78 is eligible for a "Ready" designation, without the need for any new CNG infrastructure to be deployed. PennDOT will look to nominate this portion of the corridor as "Ready" in future rounds of FHWA AFC nominations.

West of the Clean Energy in Carlisle, PA, there is not another CNG AFC station off I-81 until Knoxville, TN, 530 miles away – far greater than the FHWA-required 150 miles. However, considering that it is only 52 miles to the PA/MD border, the most strategic deployment of a CNG AFC station for the purpose of building out a national network most efficiently would be not in PA, but in MD. A new CNG AFC station in MD, within roughly 100 miles of the PA/MD border, would fill the 52-mile gap in CNG AFC infrastructure from the PA/MD border to the Clean Energy in Carlisle, and with that, make the entire focus corridor eligible for a "Ready" designation for CNG. (Note: alternatively, there is a CNG AFC station off I-70 in Frederick, MD (en route, from I-81, to Baltimore, MD and Washington, DC) that is 32 miles from I-81, but only 93 miles from the CNG station in Carlisle, PA (i.e. within 150 miles). This means that it may be possible, pending the criteria for the next round of FHWA AFC nominations, to nominate the I-81/I-70 PA/MD corridor as "Ready" for CNG.

Since the gap in CNG infrastructure west of Carlisle would be most efficiently filled by a new station in MD, and the rest of the PA I-81/I-78 corridor is already "Ready" or "Ready"-eligible, ***the deployment of a new CNG station in PA is not necessary*** for the corridor to achieve "Ready" status for its entire length. For this reason, the remainder of this Deployment Plan will prioritize identifying locations for EV infrastructure, while at the same time keeping an open mind to opportunities for new CNG stations as they arise.

Identifying Priority Locations

An In-Depth Look at Data Used to Prioritize Exit Locations for New Infrastructure; and An Identification of Potential Sites for Alternative Fuel Infrastructure

- Prioritization Process
- Analysis of Exit Locations
- Evaluating Deployment Scenarios

Identifying Priority Locations

To identify the best locations for new AFC infrastructure along the I-81/I-78 PA corridor, PennDOT conducted an analysis in two stages: 1) the prioritization of exit locations; and 2) the identification of specific sites within each of the prioritized exit locations that could fit the business model for hosting a station.

For the ***exit prioritization analysis***, all 52 exit locations along the corridor were compared using quantitative data (such as traffic volume and jobs) and other criteria (such as amenities) that were translated into quantitative terms and integrated into an overall scoring system. The exit locations were then categorized into Deployment Roles based on the gap they would fill in upgrading the eligibility of a "Pending" segment of the corridor to "Ready." The highest scoring exit locations for each Deployment Role are the priority exit locations that result from this analysis.[26]

For the ***site identification assessment***, at each of the priority exits, specific sites were identified that fit the business model for EV DC fast charging. As stated in the gaps analysis (see section *Identifying Gaps & Needs*), since the corridor is already mostly "Ready" for CNG but only "Pending" for EV, the identification of sites for EV charging was a higher priority than identifying sites for CNG fueling.[27] The site identification assessment provides important information to support outreach efforts as described later in this document.

Table 13 shows the key steps used for prioritizing exit locations and evaluating sites.

TABLE 13: Process for Prioritizing Potential Sites for AFC Stations

Stage of Analysis	Steps
Exit Prioritization	1. Identify and summarize data to support prioritization
	2. Develop exit prioritization scores based on data
	3. Group exits by AFC gap locations and other prioritization needs
Site Identification (for priority exits)	4. Evaluate types of businesses at priority exit locations
	5. Develop scenarios to address AFC designation and other planning needs

Identify and Summarize Data to Support Prioritization

Exit Prioritization

Step 1:
Identify and summarize available data

The selection of data for the prioritization of exits was based on available information from PennDOT and other regional planning sources within the state. Key data items were selected that would correlate to the economic success of DC-fast charging stations. The business models discussed previously and outreach conducted to EV network charging

[26] PennDOT explored other infrastructure prioritization tools (such as M.J. Bradley & Associates' Electric Vehicle Infrastructure Planning Tools or the U.S. Department of Energy National Renewable Energy Laboratory's Electric Vehicle Infrastructure Projection Tool) in the process of developing its methodology, but ultimately developed its own framework, since this is PennDOT's first Deployment Plan, and it was especially important to PennDOT to undertake a thorough, project-specific approach, rather than rely exclusive on a non-project-specific model.

[27] This Deployment Plan maintains that the best location for a new CNG station along the corridor, in terms of upgrading the most miles of corridor to "Ready" with the least amount of new stations, is in not in Pennsylvania, but in Maryland.

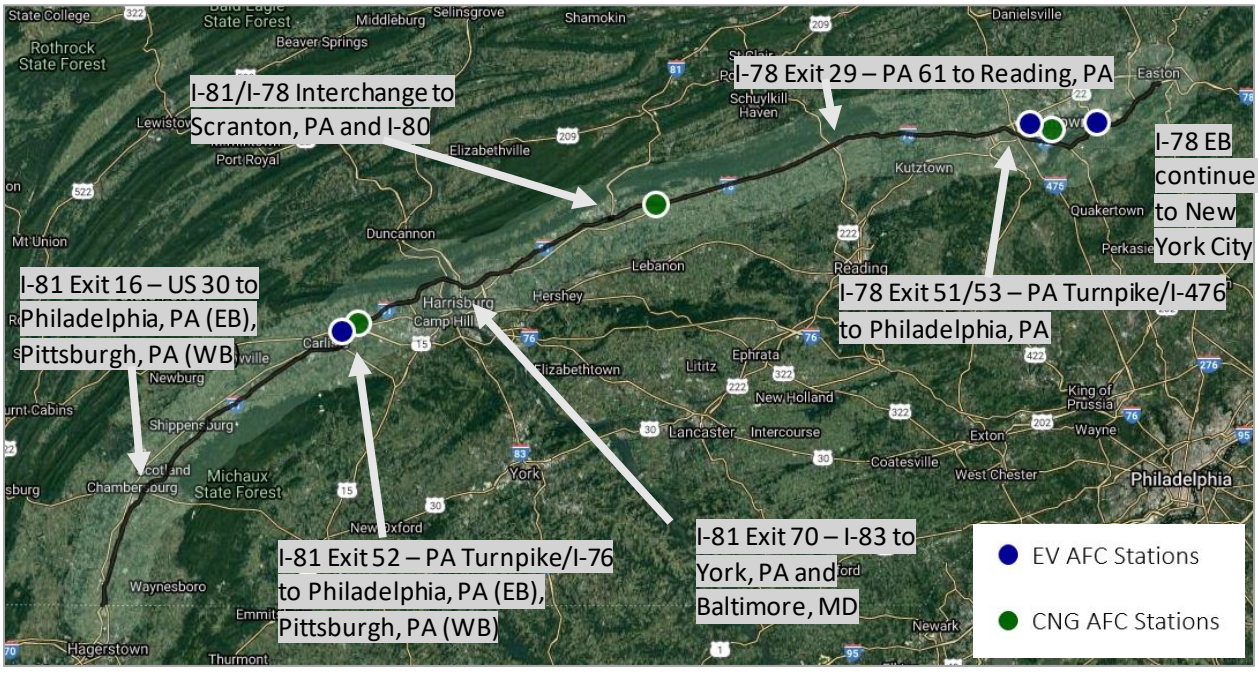
companies helped inform the selection of potential data items. PennDOT recognizes that different stakeholders – such as EV network companies and planning partners – may prefer their own methodologies and data sources for prioritizing sites. PennDOT has provided examples of the data it has collected on the corridor available in this report (and Appendix pages) for stakeholders and interested readers to use for their various organizational or individual research goals. The key data used for prioritizing exits in this deployment plan includes those listed below. The data is described in the following sections.

Data Item	Source
Whether Exit has Connection with a National Highway System (NHS) Road	NHS Mapping
Average Annual Daily Traffic (AADT) (Mainline and Ramps – if available)	PennDOT Roadway Management System (RMS) Traffic Counts and Traffic Information Repository
Average Annual Daily Truck Traffic (ADTT)	
Employment within 5mi/2mi of Corridor	PennDOT acquired employment data from Department of Labor and Industry
Exit signage for Amenities	Online resources

Corridor Connections

The I-81/I-78 corridor in Pennsylvania is a vital route within the National Highway System (NHS) network providing connections to other corridors that lead to major cities such as Philadelphia, Pittsburgh, Baltimore, and New York City. **Figure 10** highlights a few of the key corridors to which I-81/78 provides linkages. As indicated below, the corridor connects with the PA Turnpike twice: at I-81 Exit 52 in Carlisle, PA; and at I-78 Exit 51/53 in Allentown, PA. At each of these exits, there is both an existing EV AFC and CNG AFC station. These two locations give the I-81/I-78 corridor a strong foundation for AFC infrastructure, despite the large gap in EV AFC stations between them.

FIGURE 10: Corridor Connections, I-81/I-78 PA Corridor

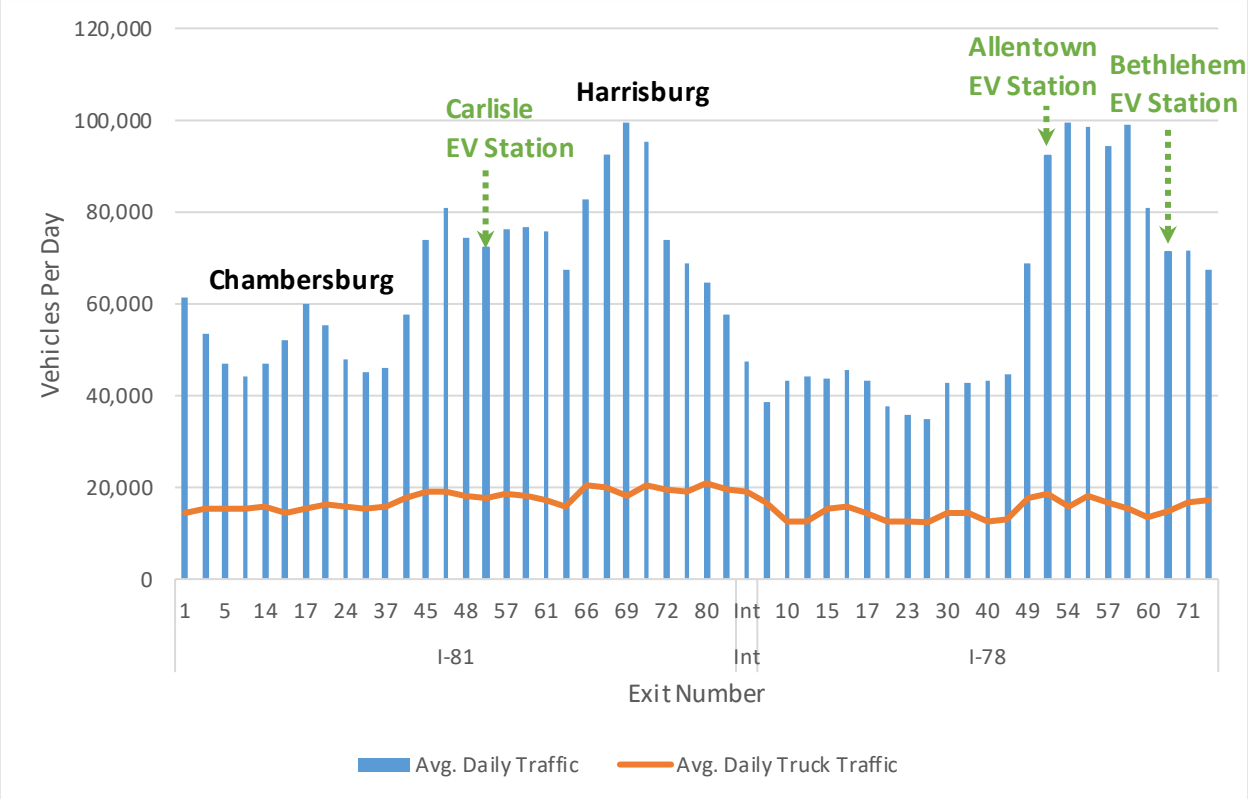


For a complete list of I-81/I-78 connections with other NHS corridors (Interstate and U.S. Routes), PA state routes, and other key high-volume roads, see Appendix **Table E**. Appendix **Table F** shows the existing signage along the highway for corridor connections.

Traffic Volume

The traffic volume along the I-81/I-78 PA corridor is among the highest in the state, trailing only the I-95, I-83, and I-76 (PA Turnpike) corridors (primary and auxiliary routes) in mean average annual daily traffic (AADT).[28] **Figure 11** shows a graph of the AADT (for both all vehicles and trucks only) at each of the 52 exit locations along the corridor. As indicated in the graph, traffic volume is highest passing through the Harrisburg and Allentown urban areas. These cities each provide connections with other high-volume routes: I-83 (Harrisburg); and the PA Turnpike/I-476 (Allentown). The next highest traffic volumes are in Carlisle (where I-81 intersects with the PA Turnpike/I-76), Chambersburg (where I-81 intersects with U.S. 30), and Bethlehem just east of Allentown. The graph also indicates the exit locations of existing EV AFC stations. As can be seen, there are opportunities to help shorten the gap between the Carlisle and Allentown EV stations by deploying a new EV station in the high-volume Harrisburg area. However, a second station would still be needed between Harrisburg and Allentown to fill the gap completely, somewhere along the lower-volume portion of I-78 between the I-81/I-78 interchange and Allentown.

FIGURE 11: Traffic Volume, All Exits, I-81/I-78 PA Corridor



Source: PennDOT Traffic Information Repository (TIRe), https://www.dot7.state.pa.us/tire

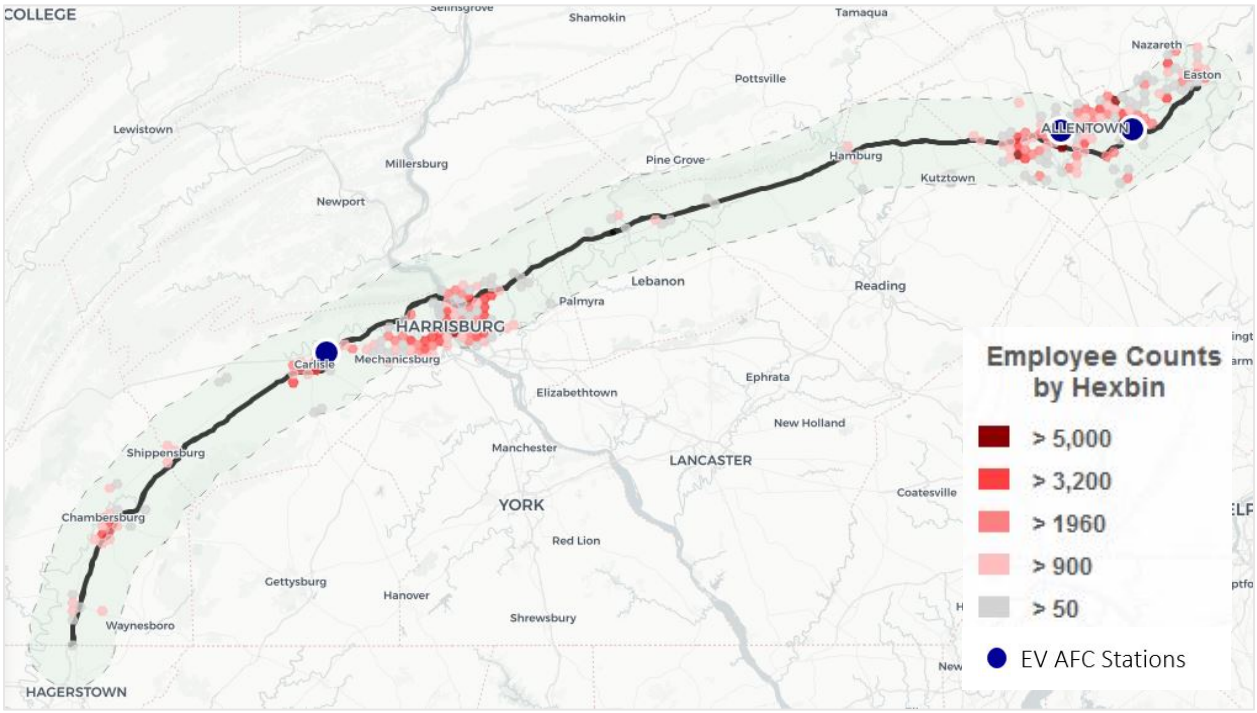
[28] PennDOT, Bureau of Planning and Research, Transportation Planning Division, PA Highway Statistics, https://gis.penndot.gov/BPR_PDF_FILES/Documents/Traffic/Highway_Statistics/Annual_Report/2019/2_Mileage_and_Travel_Selected_Routes_2018.pdf

Appendix **Table G** shows the traffic volume counts (all vehicles and trucks) for each exit along the corridor, including counts at both: 1) corridor segments passing through each location; and 2) off-ramp exits. As may be expected, off-ramp volumes are highest where the corridor connects with other key interstates, particularly at I-81 Exit 70 in Harrisburg (I-83 connection) and I-78 Exit 51 EB/53 WB in Allentown (PA Turnpike/I-76 connection).

Employment

Figure 12 shows the concentration of jobs along the corridor measured in 1-mile hexbins. As illustrated on the map, most of the jobs along the corridor are concentrated around the Harrisburg-Carlisle and Allentown-Bethlehem-Easton metropolitan areas.

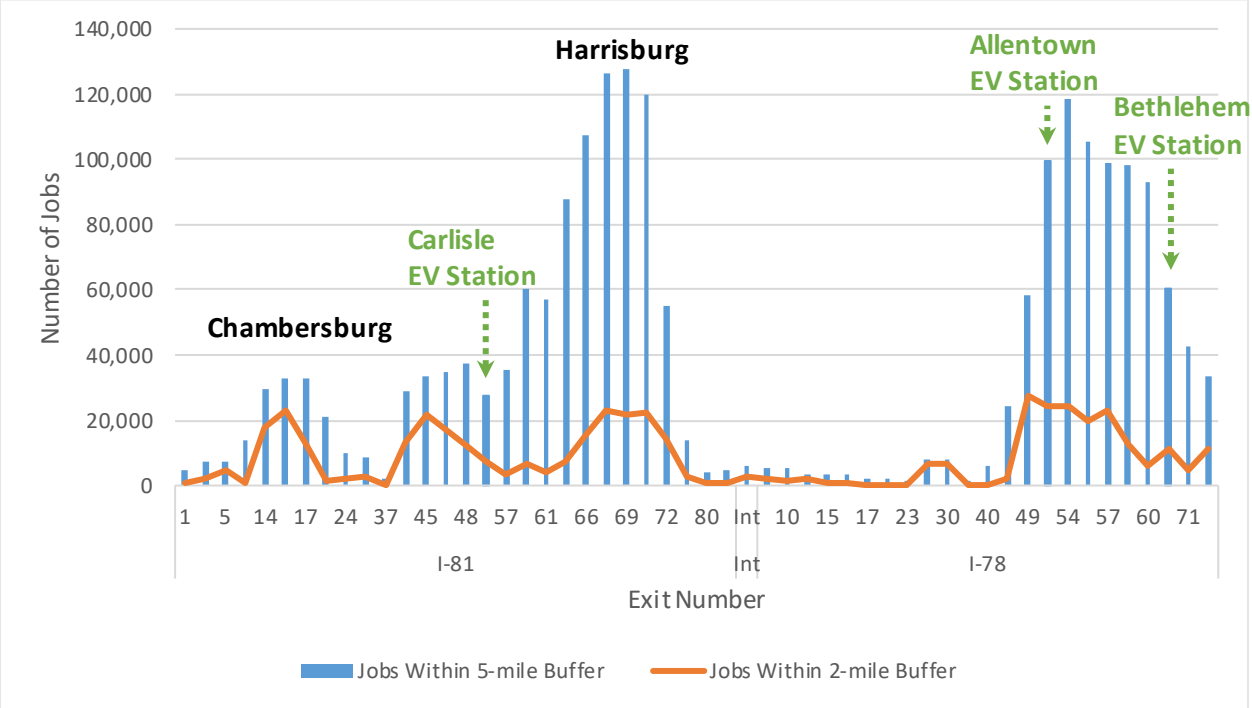
FIGURE 12: High Job Concentration Areas (1-mile Hexbin), I-81/I-78 PA Corridor



Source: Pennsylvania Department of Labor and Industry, 2018

Figure 13 shows the total number of jobs at each of the 52 exit locations along the corridor, within both a 5-mile and 2-mile buffer. The 5-mile buffer is shown, because FHWA criteria requires that AFC EV and CNG stations be located no greater than 5 miles off the highway. However, since this metric skews heavily towards the urban areas of Harrisburg and Allentown, a 2-mile buffer is also shown. This Deployment Plan utilizes this metric (2-mile buffer) for prioritizing exit locations, because it shows more variance among exit locations within the same urban area. Within the 95-mile gap between the existing EV AFC stations in Carlisle and Allentown, the highest job concentrations within 2-miles of the interstate are located along I-81 in Harrisburg. Between Harrisburg and Allentown, where a new EV AFC station is needed to fill this gap, the highest concentrations of jobs within 2-miles of the corridor are at I-78 Exits 29 and 30, near the PA-61 connection to Reading.

FIGURE 13: Jobs Within 5-Mile and 2-Mile Buffer, All Exits, I-81/I-78 PA Corridor



Source: Pennsylvania Department of Labor and Industry, 2018

Appendix **Table H** shows the total number of employees who work at locations within 5 miles of the corridor by NAICS industry sector relative to the industry mix for PA. The top employment sector along the corridor is Health and Social Assistance (16.4%); the second highest is Retail Trade (10.9%). The highest location quotient among sectors is Transportation and Warehousing, which has nearly twice (1.81 times) the industry share along the corridor (8.5%) as Pennsylvania (4.7%). This is significant because it includes jobs, such as trucking, at businesses or agencies that may manage alternative fuel vehicle fleets and/or operate alternative fuel infrastructure. In total, there are nearly 600,000 jobs located within 5 miles of the corridor, roughly 10% of all jobs in the entire state.

For more detailed information on employment characteristics of the area within 5 miles of the corridor, including employee demographics, commuter travel patterns, job growth by metropolitan/micropolitan area, and job growth by census-designated place, see Appendix **Tables I-L**.

Amenities Signage

In addition to signaling connections to other corridors, highway signage also alerts drivers to the availability of different amenities and other features at each given exit location. This is especially important for long-distance drivers who may be unfamiliar with the area they are passing through, including users of EV DC fast charging stations looking for on-site or other nearby amenities to occupy the 20-30 minutes it takes to charge their vehicle. Exit locations that alert drivers to the availability of food, including both restaurants and gas stations that offer convenience store food, have a clear advantage over others when it comes to attracting EV drivers looking for a good place to stop to charge their vehicle.

Table 14 shows the existing highway signage along the corridor for the standard features: Food, Gas, Lodging, Hospital, State Police, Camping, and Information. In total, out of 52 exits along the corridor, 37 alert drivers to Food, and 36 alert drivers to Gas (which typically includes convenience store food).[29] The availability of lodging is more relevant for properties looking to install EV Level 2 stations.

TABLE 14: Highway Signage – Features/Amenities, by Exit Location, I-81/I-78 PA Corridor

Route	Exit	FOOD	GAS	LODGING	HOSPITAL	STATE POLICE	CAMPING	INFORMATION
I-81	1	•		•			•	
	3	•	•	•				
	5	•	•	•	•			
	10							
	14	•	•					
	16	•	•	•	•	•		
	17							
	20	•	•	•				
	24	•	•					
	29	•	•	•	•			
	37							
	44	•	•		•	•		
	45	•	•	•	•		•	•
	47	•	•	•				
	48/49	•	•					
	52	•	•	•				•
	57							
	59							
	61	•			•			
	65	•	•	•				
	66	•		•	•			
	67							
	69	•	•	•		•		
	70							
	72	•	•	•				
	77	•	•	•	•	•		
	80		•	•				
	85	•	•	•				
Int.	90/1	•	•	•		•	•	
I-78	6/8	•	•				•	
	10	•	•	•				
	13	•	•					
	15							

[29] PA Highways, https://www.pahighways.com/interstates/

Route	Exit	FOOD	GAS	LODGING	HOSPITAL	STATE POLICE	CAMPING	INFORMATION
	16	•	•	•				
	17	•		•				
	19	•	•					
	23	•	•	•			•	
	29	•	•	•				
	30		•					
	35	•						
	40	•	•	•				
	45	•	•	•				
	49	•	•	•				
	51/53			•				
	54	•	•	•				
	55		•		•			
	57	•	•	•	•			
	58/59	•	•					
	60							
	67	•	•		•			
	71							
	75		•	•				
Corridor Total		**37**	**36**	**29**	**11**	**5**	**5**	**2**

Source: PA Highways, https://www.pahighways.com/interstates/

Additional Data to Support Exit Prioritization

Although not used directly to support the quantitative exit prioritization scoring, PennDOT has evaluated other data sources for potential application in deployment plans.

Alternative Fuel Registration Data - Understanding the current location of electric and hybrid vehicle registrations can provide some additional insights into the usage-levels of DC-fast charging stations. PennDOT's Bureau of Motor Vehicles (BMV) releases annual reports updating its total vehicle registrations including a summary of vehicles by fuel type and county. **Table 15** shows the number of registrations for both EV and CNG for all counties from which workers employed within 5 miles of the corridor commute. This is important because road users of the corridor including tens of thousands of employees, may live in, and register their vehicle in, counties through which the interstate does not cut through directly. Hybrid vehicle registration counts are also included, despite hybrids not being compatible with DC fast charging because they may be viewed as a useful indicator of driver interest in alternative fuels and future AFC station demand. According to the BMV, there were 524 compressed gas, 7,694 electric, and 30,037 hybrid vehicles registered in PA, out of 12 million vehicles total, as of December 31, 2018. Among counties from which corridor employees commute, EV registrations are most common in Montgomery County, and second-most in Bucks County – both of which are located between Allentown and Philadelphia.

TABLE 15: EV and CNG, & Hybrid Registration, by County of Residency for Corridor Employees

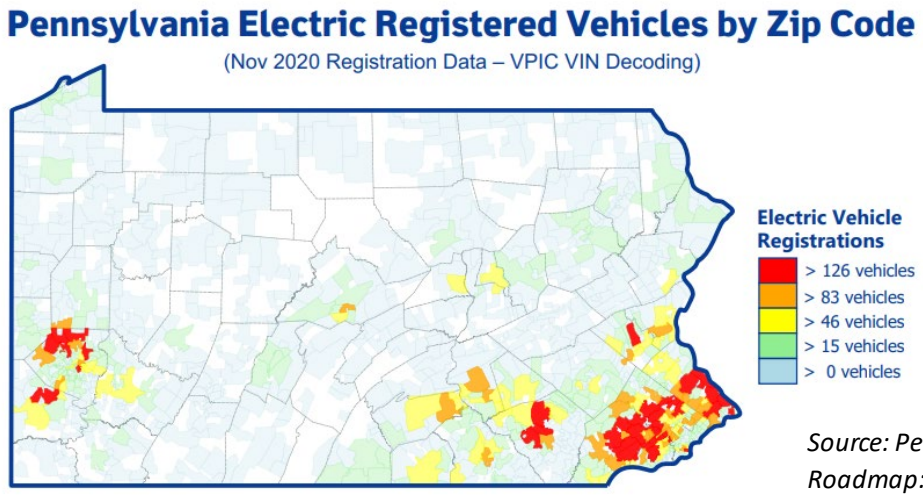
Counties of Commuting Origin	Jobs in Corridor, by County Where Worker Lives	EV Registrations	CNG Registrations	Hybrid Registrations
All Counties	588,484			
Lehigh	99,786	434	14	1,258
Cumberland	71,868	280	8	745
Northampton	69,512	335	31	1009
Dauphin	68,082	247	7	760
Franklin	34,776	71	14	686
York	24,977	375	22	1,743
Berks	23,260	280	13	1,123
Lancaster	13,640	431	19	2,240
Lebanon	13,436	62	4	373
Bucks	11,968	1,422	137	2,335
Perry	10,924	18	1	84
Montgomery	10,746	2,205	103	3,502
Philadelphia	8,699	934	55	4,378
Schuylkill	8,320	35	4	252
Pennsylvania Total	State Total in 2020	15,205	1,003	42,898
	Growth From 2018	***+98%***	***+91%***	***+43%***

Source: PennDOT 2020 Registration Data
http://www.dot.state.pa.us/public/DVSPubsForms/BMV/Registration%20Reports/ReportofRegistrations2020.pdf

Additional resources have recently become available through the Pennsylvania Electric Vehicle Roadmap, a resource prepared by PA DEP to provide a vision and strategy to promote electric vehicle usage in the state. **Figure 14** provides an example of new resources and online mapping to understand the location of electric and hybrid vehicle registrations. The information can support the evaluation of potential corridor charging needs.

Origin-Destination Data – The economic benefits of DC fast-charging is typically focused on longer distance travel. PennDOT's discussion's with EV network companies have highlighted the importance of understanding the origins-destinations of travelers at locations where DC-fast charging is being considered for implementation. In fact, multiple EV network companies indicated that they purchase and use origin-destination data as part of their decision-making process. To support this study, PennDOT purchased and evaluated origin-destination data from StreetLight, Inc. For exits within the study's defined AFC infrastructure gaps, an assessment was conducted on the I-81/I78 traffic near that exit to determine the percentage of long-distance travelers. **Table 16** provides a summary of the information produced from the assessment. The data can support exit prioritization and also provide insights into the potential market for DC-fast charging stations. PennDOT will share this information with interested businesses and network companies as part of this deployment effort and continue to explore the role such data can play in future deployment plans.

FIGURE 14: 2020 Pennsylvania Electric Registered Vehicles by Zip Code, PennDOT Registration Data



Source: Pennsylvania Electric Vehicle Roadmap: 2021 Update; Map Link

TABLE 16: Weekday-Weekend Trip Lengths for Passenger Vehicles, I-81/I-78 PA Corridor (Streetlight, 2019)

Weekday Trip Lengths

Exit	0-5 mi.	5-25 mi.	25-50 mi.	50-100 mi.	100+ mi.	Exit Role in Filling EV AFC Gaps (Described in Future Section: Table 17)
I-81 Exit 16	20.2%	31.0%	14.5%	15.4%	18.9%	Gap 1: MD to Carlisle*
I-81 Exit 47	20.7%	30.9%	19.1%	12.8%	16.5%	Carlisle Station Alternative
I-81 Exit 72	11.7%	41.0%	14.3%	15.8%	17.2%	Gap 2: Carlisle to Allentown, West*
I-81 Exit 90	6.5%	23.3%	26.3%	23.0%	21.0%	I-81/I-78 Interchange
I-78 Exit 29	5.4%	19.5%	26.6%	23.4%	25.1%	Gap 3: Carlisle to Allentown, East*
I-78 Exit 54	22.8%	47.5%	10.3%	13.1%	6.3%	Allentown-Bethlehem Station Alternative
I-78 Exit 75	4.5%	33.0%	17.3%	33.6%	11.6%	Gap 4: Bethlehem to NJ†

Weekend Trip Lengths

Exit	0-5 mi.	5-25 mi.	25-50 mi.	50-100 mi.	100+ mi.	Exit Role in Filling EV AFC Gaps
I-81 Exit 16	18.5%	26.7%	15.2%	17.0%	22.5%	Gap 1: MD to Carlisle *
I-81 Exit 47	15.3%	29.1%	19.0%	15.8%	20.9%	Carlisle Station Alternative
I-81 Exit 72	9.6%	36.7%	13.9%	18.9%	21.0%	Gap 2: Carlisle to Allentown, West*
I-81 Exit 90	4.7%	22.6%	24.8%	24.7%	23.1%	I-81/I-78 Interchange
I-78 Exit 29	6.7%	15.8%	27.7%	23.2%	26.6%	Gap 3: Carlisle to Allentown, East*
I-78 Exit 54	20.1%	42.2%	11.4%	17.3%	9.0%	Allentown-Bethlehem Station Alternative
I-78 Exit 75	3.4%	31.0%	16.0%	37.8%	11.7%	Gap 4: Bethlehem to NJ†

*Gaps 1-3 are priorities to be filled in PA

†Gap is only 10 miles and would be more efficiently filled with station in NJ

Exit Prioritization Scoring

Exit Prioritization

Step 2:
Develop and apply an exit scoring system

For this deployment plan, PennDOT has developed a quantitative scoring system to provide a prioritization value to each of the 52 exits along the I-81/I78 corridor based on the data provided in the previous sections. Scoring systems can be developed in many ways; and, PennDOT expects that the current process can be further enhanced and expanded for future deployment plan activities.

The current process was developed in EXCEL using the available data for each exit location. A scoring value was used for each data item and then added to obtain the total exit score. The methods used for scoring are summarized below:

Data Item	Scoring Method
Total Traffic Volume	▪ Apply EXCEL PERCENTILE.INC function to each exit volume ▪ If volume is in highest 20% of all exits, Score = 4 ▪ If volume is in highest 40% of all exits, Score = 3 ▪ If volume is in highest 60% of all exits, Score = 2 ▪ If volume is in highest 80% of all exits, Score = 1 ▪ Otherwise score = 0
Truck Volume	▪ Treated as a bonus score point ▪ Apply EXCEL PERCENTILE.INC function to each exit volume ▪ If truck volume is in highest 20% of all exits, Score = 1 ▪ Otherwise score = 0
Ramp Volume	▪ Treated as a bonus score point ▪ Same scoring as truck volume
Employment	▪ Same scoring as Total Traffic Volume above, except based on total employment within a 2-mile buffer of corridor
NHS Connections	▪ Treated as a bonus score point ▪ If exit connects to a National Highway System (NHS) route then an additional score point is assigned
Amenities	▪ Based on exit amenities (points are additive) ▪ If food available then Score = 1 ▪ If gas or related amenities available then Score = 1 ▪ If other commercial amenities available then Score = 1-3 (assigned manually by reviewing businesses at each exit)

Prioritization of Exits by AFC Gap Locations

Exit Prioritization

Step 3:
Group exits by AFC gap locations and other prioritization needs

To prioritize exit locations, it is useful to create several different categories based on the role that each location would have in upgrading its corridor segment to "Ready" were a new station to be deployed there. This is particularly important when there are: a) multiple gaps that need to be filled along a corridor; and b) metropolitan areas, such as Harrisburg-Carlisle and Allentown-Bethlehem-Easton, that can often skew the data to exit locations that are relatively close together and would therefore be less effective at filling corridor gaps. **Table 17** shows how this Deployment Plan defines the role of each exit location according to each corridor segment. Exits given the role of filling gaps ("Fill Gaps 1-3" in the table below)

are defined as those within 20-50 miles of the nearest EV AFC station. Exits given the role of providing an alternative to an existing station ("Existing Station Alternative" in the table below) are defined as being within 20 miles of each existing EV AFC station. While the purpose of this Deployment Plan is primarily to prioritize the exits that fill the gaps, this latter category is also important to include for the long-term planning of the corridor since each of the existing EV AFC stations exist in high-volume areas where demand for additional stations may increase in the next several years. Note that since the exit locations of I-78 Exits 6/8 and 10 could both serve to fill the Carlisle-Allentown gap on their own (within 20-50 miles of both the Carlisle and Allentown stations), they are included in both the "Fill Gap 2" and "Fill Gap 3" Carlisle-Allentown categories, and identified with an asterisk. Exits that are within 20 miles of an existing AFC station but could still play the role of filling a gap are identified with a dagger.

TABLE 17: Deployment Roles for Exit Locations in Filling Gaps Along Corridor

Deployment Role	Exit Locations	Criteria Defining Role: Distance from nearest EV AFC stations	"Ready" Upgrade
Fill Gap 1: Hagerstown (MD) to Carlisle	I-81 (3, 5, 10, 14, 16, 17, 20, 24, 29)	Within 50 miles of MD station, and within 20 to 50 miles of Carlisle station	EV: Hagerstown to Carlisle CNG: Carlisle to location of new station
Existing Station Alternative (Carlisle; I-81 Exit 52)	I-81 (37†, 44, 45, 47, 48/49, 52, 57†, 59†, 61†, 65†, 66†, 67†, 69†, 70†)	Within 20 miles of Carlisle station	EV: Carlisle to location of new station
Fill Gap 2: Carlisle to Allentown, West	I-81 (72, 77, 80, 85, 90), I-78 (1, 6/8*, 10*)	20 to 50 miles east of Carlisle station	EV: Carlisle to location of new station (alone); Carlisle to Bethlehem (when paired)
Fill Gap 3: Carlisle to Allentown, East	I-78 (6/8*, 10*, 13, 15, 16, 17, 19, 23, 29, 30)	20 to 50 miles west of Allentown station	EV: Bethlehem to location of new station (alone); Carlisle to Bethlehem (when paired)
Existing Station Alternative (Allentown; I-78 Exit 51/53)	I-78 (35†, 40†, 45†, 49†, 51/53, 54, 55, 57, 58/59, 60, 67, 71)	Within 20 miles of Bethlehem station	EV: Allentown to location of new station
"Ready"-Eligible from Allentown to Bethlehem			
Existing Station Alternative (Bethlehem; I-78 Exit 67)	I-78 (67, 71, 75)	Within 20 miles of Bethlehem station	EV: Bethlehem to location of new station

*New station at exit may be deployed to fill gap from Carlisle to Allentown gap on its own. However, since the FHWA distance criteria also factors in the distances from the exits to the stations, a viable site would have to be identified that is right off the interstate, with a narrow margin for flexibility.

†New station may also be deployed at exit in "Fill Gap" role. However, for the Carlisle to Allentown gap (for which, to fill, these locations would have to be paired with a second), the range of potential second exit locations that these stations must be paired with becomes more limited the closer the station is to an existing one.

Table 18 shows the results of the exit prioritization analysis, including rankings of the top exit locations within each deployment role category. As expected, the highest scoring areas are in the Harrisburg and Allentown metro areas. This underscores the importance of defining deployment roles for each exit by dividing the corridor into segments and prioritizing within each of them. For the MD to Carlisle gap, the

top exit locations are at I-81 Exits 14-17 in the Chambersburg area where there are high jobs and amenities and a corridor connection with US-30. This is also the only gap that is "Pending" for CNG. For the Carlisle to Allentown gap, which could be filled by a single station at either I-78 Exit 6/8 or I-78 Exit 10 (a limited 3-mile stretch of corridor) or by two new stations along a much greater range of exits to consider, the top exit locations are: on the western portion of the gap, I-81 Exits 72-77 in the Harrisburg area; and on the eastern portion of the gap, I-78 Exit 29 near Hamburg, PA.

TABLE 18: Exit Prioritization Results: Priority Exit Location

Deployment Role	Rank	Exit	County	Score	Notes
Fill Gap 1: Hagerstown (MD) to Carlisle	1	16 (I-81)	Franklin	11	High jobs and amenities; US-30 connection
	2	14 (I-81)	Franklin	9	High jobs
	3T	17 (I-81)	Franklin	8	High amenities
	3T	29 (I-81)	Cumberland	8	High amenities
Carlisle Station Alternative	1	70 (I-81)	Dauphin	14	High traffic, jobs, and amenities; I-83 connection; Existing Tesla Supercharger
	2T	45 (I-81)	Cumberland	13	High jobs and amenities
	2T	47 (I-81)	Cumberland	13	High traffic and amenities
	2T	52 (I-81)	Cumberland	13	High amenities; NHS connection; Existing EV AFC station; Existing CNG AFC station; Existing Tesla Supercharger
	2T	69 (I-81)	Dauphin	13	High traffic, jobs, and amenities
Fill Gap 2: Carlisle to Allentown, West	1	72 (I-81)	Dauphin	13	High amenities; NHS connection
	2	77 (I-81)	Dauphin	9	High amenities
	3	90/1 (Int)	Lebanon	6	I-81 connection to northern PA
Fill Gap 3: Carlisle to Allentown, East	1	29 (I-78)	Berks	7	High amenities; PA-61 connection to Reading
	2	13 (I-78)	Berks	5	Some amenities
	3	23 (I-78)	Berks	4	Some amenities
Allentown-Bethlehem Station Alternative*	1	54 (I-78)	Lehigh	15	High traffic, jobs, and amenities; NHS connection; Existing EV AFC station; Existing Tesla Supercharger
	2T	51/53 (I-78)	Lehigh	14	
	2T	57 (I-78)	Lehigh	14	Commercial corridor; High traffic, jobs, and amenities; CNG station
	4	49 (I-78)	Lehigh	13	High jobs and amenities

*Station at exit would serve as alternative to both the Allentown and Bethlehem existing stations

The exits highlighted in green can be considered the first priority locations of this Deployment Plan. Put simply, new EV AFC stations at each of the three top-ranked "Fill Gap" locations – for example, at I-81

Exit 16, I-81 Exit 72, and I-78 Exit 29 - would fulfill the FHWA distance criteria required to upgrade the PA corridor to "Ready" for EV for 156 miles of the 166-mile corridor, from the MD border to Bethlehem, PA.

Secondary Priority Locations

As EVs become more widely adopted, it will become more important to consider the potential for additional EV stations at exit locations where one EV station already exists. This is particularly important on the I-81/I-78 corridor, where the existing EV AFC stations are each at least a couple of miles off the highway. While sufficient in meeting FHWA AFC requirements, it would be more convenient for EV drivers if the stations were right off the interstate (<1 mile). Since drivers are used to the convenience of gas stations that are often right off the interstate; it is important to shape the AFC network of stations into one that can compete with the traditional fuel network as best as possible (despite obvious inherent differences). The top-ranked exit location for deploying an alternative to the existing Carlisle station is I-81 Exit 70 in Harrisburg, PA (Lower Paxton Township), where there is high traffic, jobs, and a connection to I-83. The top-ranked exit location for an alternative to the existing Allentown and Bethlehem stations is I-78 Exit 54 in Allentown, PA (South Whitehall Township), where traffic volume and employment are both among the highest along the corridor.

Another way to think about second priority locations (if the first priority locations are focused on filling the gaps in AFC infrastructure) is to target deployment in areas where the demand potential is greatest: metropolitan areas. Beyond simply scoring high in the metrics used to prioritize locations in this Deployment Plan (traffic volume, jobs, etc.), metro areas are also important locations for public stations because of their higher populations of people living in multi-family housing. Since multi-family residents may not have a dedicated parking space to charge their vehicle at home, then they would be dependent on public EV stations to charge their vehicle. For this reason, in the future, even after the corridor is upgraded to "Ready," the deployment of additional stations in the Carlisle-Harrisburg and Allentown-Bethlehem-Easton metropolitan areas should continue to remain under consideration for new EV AFC stations.

CNG Station Priorities

The MD to Carlisle gap is the only gap that is "Pending" for both EV and CNG; the rest of the corridor is already "Ready" or "Ready"-eligible for CNG. However, deploying an EV station to fill this gap is more efficient than deploying a CNG station to do the same. A new EV station at this exit would upgrade the corridor to EV-"Ready" from Carlisle all the way to Hagerstown, MD (the location of the next EV station), while a new CNG station at this location would upgrade the corridor to CNG-"Ready" only from Carlisle to the exit location of the new CNG station, since there is no CNG station on I-81 in MD. A more efficient deployment of a CNG station would be along the corridor in MD, between 50 and 100 miles south of the PA/MD border. This would create a distance of between 100 and 150 miles from the existing CNG station in Carlisle and the new station in MD, which would be within the 150-mile CNG-"Ready" requirement set by FHWA. PennDOT will prioritize opportunities to coordinate with the Maryland Department of Transportation (MDOT) and other MD-based transportation and planning agencies on the deployment of this station. (PennDOT and MDOT recently coordinated on the AFC nomination of US-15).

Evaluating Potential Sites at Priority Exits

Following the exit prioritization process, the second stage of analysis is to look more closely at what land uses and commercial establishments currently exist off each priority exit that could potentially support EV DC fast charging. This section details the existing land uses and specific sites that have this potential.

Identifying Site Locations:

Step 4:
Evaluate types of businesses at priority exit locations that may be good locations for AFC infrastructure

Businesses Currently Hosting DC Fast Stations in PA

Table 19 shows the different types of properties that currently host EV DC fast infrastructure in Pennsylvania, as well as the property-network partnerships that exist for each. This includes 32 stations that host both CHAdeMO and CCS connector types, and 49 stations that only host only one type of DC fast connector: CHAdeMO, CCS, or Tesla. As shown in the table, existing service stations providing convenience and gas make up about one-quarter of the properties. Besides service stations, the other land uses in PA that currently host EV DC fast charging include: auto shops (18); shopping centers/plazas (17); restaurants (10); department stores (4; all Walmarts); hotels (2); and various other facility parking lots (9).

Since the business models for hosting EV DC fast infrastructure all rely to some degree on customer attraction to on-site amenities for at least the 20-30 minutes that fast-charging takes, the most obvious potential hosts, along with convenience/gas stations, are restaurants since 20-30 minutes is conveniently also about how long it takes to order and eat a meal. In PA, the only restaurant with more than one establishment hosting EV DC fast infrastructure is Dunkin, which hosts seven stations in PA and 39 nationally. All seven of Dunkin's PA EV DC fast stations are owned and operated by the charging network EVgo.

Table 20 shows a sample of some of the existing businesses at the top-ranked exit locations along the corridor. As indicated in the table, there is at least one convenience/gas station and one restaurant at each of the locations. Most of these top-ranked exit locations also include a grocery store and shopping center – two other land uses that may attract customers for 20-30 minutes. At each of them, there is at least one commercial franchise establishment that already hosts EV DC fast stations at one or more of their other locations in the state, including Sheetz (17 in PA), Nissan (9), Dunkin (8), Harley-Davidson (5), Walmart (4), and Rutter's (2) as franchises that host at least two such stations in PA. In addition, Weis Markets, which hosts one station in PA (a Tesla Supercharger station in Bellefonte, PA near the I-80/I-99 interchange), is an appealing type of business for hosting EV DC fast stations in that its locations may offer all of gas, food, groceries, shopping (often being located within shopping centers/plazas), and large parking lots with plenty of room for EV chargers.

Other multiple-use establishments like Weis, that often double (or triple) as both service stations and other commercial land uses (food, grocery, and/or retail) include: other gas/grocery chains such as Giant; and service/travel centers such as Love's and Pilot Flying J. Gas and grocery combination establishments, especially, like Weis and Giant, present unique long-term opportunities for hosting EV charging stations should certain cultural and technological trends continue including: the growth of ridesharing (for shoppers who choose not to, or cannot afford to, own a car); online grocery shopping

and the need for larger grocery delivery fleets;[30] and the development of autonomous vehicles, such as Walmart's announcement last year of a pilot program to use a fleet of driverless EVs to deliver groceries.[31]

TABLE 19: PA Properties Hosting EV DC Fast Infrastructure, by EV Network Company

Owner	PA DC Fast Sites	Blink	Charge Point	Electrify America	EVgo	Green-lots	Non-Network	Tesla
Total	**81**	**9**	**8**	**10**	**18**	**1**	**13**	**22**
Auto	**18**	**0**	**7**	**0**	**1**	**0**	**10**	**0**
Nissan	9	0	1	0	0	0	8	0
Harley-Davidson	5	0	5	0	0	0	0	0
Jaguar Land Rover	1	0	1	0	0	0	0	0
John Sisson Motors	1	0	0	0	0	0	1	0
Liberty Car Wash	1	0	0	0	1	0	0	0
Wright Automotive	1	0	0	0	0	0	1	0
Convenience/Gas	**21**	**0**	**1**	**4**	**2**	**0**	**2**	**12**
Sheetz	17	0	0	4	0	0	2	11
Rutter's	2	0	0	0	2	0	0	0
Royal Farms	1	0	1	0	0	0	0	0
Weis Markets	1	0	0	0	0	0	0	1
Food	**10**	**0**	**0**	**0**	**8**	**0**	**0**	**2**
Dunkin' Donuts	7	0	0	0	7	0	0	0
Arby's	1	0	0	0	1	0	0	0
Ruby Tuesday's	1	0	0	0	0	0	0	1
Wendy's	1	0	0	0	0	0	0	1
Hotel	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**2**
Hilton	1	0	0	0	0	0	0	1
Marriott	1	0	0	0	0	0	0	1
Other	**30**	**9**	**0**	**6**	**7**	**1**	**1**	**6**
Shopping Ctr/Plaza	17	5	0	2	5	0	0	5
Walmart	4	0	0	4	0	0	0	0
Parking Lot/Garage	3	2	0	0	0	0	0	1
City of York	1	0	0	0	1	0	0	0
Gettysburg Nat. Park	1	0	0	0	0	0	1	0
Harrisburg Airport	1	1	0	0	0	0	0	0
Lankenau Medical	1	1	0	0	0	0	0	0
Lehigh University	1	0	0	0	0	1	0	0
Oxford Athletic Club	1	0	0	0	1	0	0	0

Source: U.S. Department of Energy, Alternative Fuels Data Center, 2020, https://afdc.energy.gov/data_download

[30] Supermarket News, 2020, https://www.supermarketnews.com/online-retail/online-grocery-sales-grow-40-2020
[31] Digital Trends, 2019, https://www.digitaltrends.com/news/walmart-grocery-delivery-to-use-electric-autonomous-cars/

TABLE 20: Sample of Existing Businesses at Priority Exit Locations, I-81/I-78 PA Corridor

Deployment Role	Rank	Exit	Gas	Food	Grocery	Shopping Center	Sample of Franchises w/ Existing EV DC Fast Station in PA
Fill Gap: MD to Carlisle	1	16	X	X	X	X	Sheetz, Walmart, Harley-Davidson, Nissan, Dunkin, Arby's, Wendy's
	2	14	X	X	X	X	Sheetz, Dunkin, Arby's, Wendy's, Weis
	3T	17	X	X	X	X	Sheetz
	3T	29	X	X	X	X	Sheetz, Rutter's Walmart, Wendy's
Carlisle Station Alternative	1	70	X	X	X	X	Sheetz, Dunkin, Arby's, Wendy's
	2T	45	X	X	X	X	Arby's
	2T	47	X	X	X	X	Walmart, Wendy's
	2T	52	X	X			Sheetz, Rutter's, Dunkin, Arby's, Marriott
	2T	69	X	X		X	Dunkin, Wendy's, Marriott, Hilton
Fill Gap: Carlisle to Bethlehem, West	1	72	X	X	X	X	Sheetz, Dunkin, Harley-Davidson, Arby's, Wendy's
	2	77	X	X			Sheetz, Dunkin
	3	90/1	X	X			Dunkin, Wendy's, Marriott
Fill Gap: Carlisle to Bethlehem, East	1	29	X	X	X	X	Sheetz, Walmart, Dunkin, Rutter's, Arby's, Wendy's
	2	13	X	X			Sheetz
	3	23	X	X			Dunkin
Allentown-Bethlehem Station Alternative	1	54	X	X	X	X	Dunkin, Walmart, Weis, Wendy's
	2T	51/53	X	X	X	X	Dunkin, Jaguar, Wendy's
	2T	57	X	X	X	X	Dunkin, Arby's, Wendy's
	4	49	X	X	X	X	Dunkin, Weis, Arby's, Marriott, Hilton

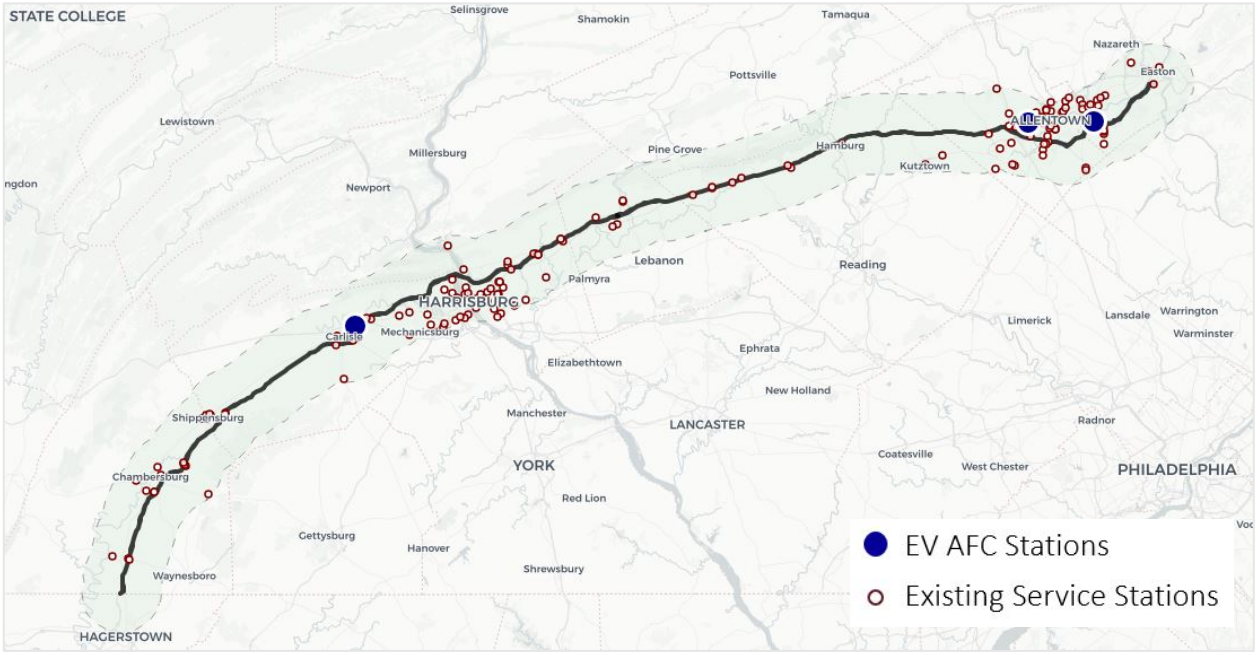
Corridor Service Stations

Existing service stations are logical locations for deploying alternative fuel infrastructure. Drivers of traditional vehicles are used to stopping for gas at service stations, so it would be an easy transition for that same driver, should they choose to next purchase an EV, to charge up at the same type of location with which they are familiar. Granted, EV charging takes longer than traditional fueling, so ideally, the site would offer additional amenities that could occupy the driver's time for the 20-30 minutes of DC fast charging that is necessary. However, service stations today often do offer such amenities, particularly off interstates, where they may double as small food and/or retail centers. Viewed in this light, existing service stations may be more than capable of implementing the cost recovery business model: less reliant on generating revenue from the direct sale of alternative fuel, and more interested in the increased customer attraction and expenditure on on-site amenities. Furthermore, service stations are often co-located at rest/truck stops with other amenities that can occupy a driver's time in a

complementary way. For example, even if the service station alone does not provide a comfortable 20-minute dining experience, a driver can choose to eat at the co-located restaurant while still buying a cup of coffee or some snacks at the service station.

Figure 15 shows 168 existing service stations within 5 miles of the corridor. Most of these gas station companies will be familiar to the typical PA driver, including among others: Citgo, Exxon, Giant, Gulf, Hess, Liberty, Love's, Rutter's, Sheetz, Sunoco, Shell, Sunnyway, Turkey Hill, and Wawa. Several service stations of particular significance to the existing EV AFC network include: Sheetz (49 EV DC fast stations nationally, and 17 in PA); Wawa (23 stations nationally (22 with Tesla), but none in PA); Royal Farms (22 nationally, all in MD and DE, except for 1 in PA); and Shell (which purchased the EV network company Greenlots in 2019).[32] Sheetz has 21 locations within 5 miles of the I-81/I-78 corridor in PA, including 12 within 1 mile. Two of these Sheetz corridor locations currently host EV DC fast stations (1 AFC, 1 Tesla), both at I-81 Exit 52 in Carlisle, PA.

FIGURE 15: Existing Service Stations, I-81/I-78 PA Corridor



Deployment Scenarios to Address AFC Needs

Identifying Site Locations:

Step 5:
Finalize AFC deployment scenarios addressing short and long term goals

In planning for alternative fuel infrastructure, it is important to balance both short and long-term interests. While the explicit purpose of this Deployment Plan is short-term – to upgrade the I-81/I-78 corridor to "Ready" – an additional role for this plan is to support future EV charging infrastructure demand and needs. The reality is that the build-out of the AFC network does not end with upgrades to "Ready" designations. Rather, as alternative fuel vehicles become more prevalent, it follows that demand for public AFC stations will increase and that current FHWA-requirements may not be enough. Just as

[32] NREL Dataset

FHWA, in Round 1 of its AFC nominations, allowed Level 2 EV stations to count towards "Ready" designations, it may be the case that future EV stations would be required to be not within 5 miles of the interstate, but within 2 miles; or that stations be required to have at least 4 outlets of CHAdeMO & CCS, rather than just 1 of each; or that stations be within 25 miles of each other, rather than 50 miles. But of course, beyond just the "Ready" designation, the much larger goal of the Deployment Plan is to reduce CO2 emissions, and this means laying the groundwork for as many new alternative fuel stations as can contribute to meeting our emissions goals. Quite simply, the more alternative fuel stations that can be deployed strategically, the more attractive it will be for drivers to switch to vehicles that use alternative fuels, and the cleaner our air will be.

To address both the short-term (1-2 years) and long-term (3-5 years) goals of this study, two scenarios are presented for the deployment new EV AFC stations, as follows. **Table 21** provides a "Fill Gaps" scenario for EVs, in which new EV AFC stations are deployed at the three exit locations that would "fill the gap" for 156 miles of the 166-mile corridor, from the MD state line to the existing station in Bethlehem, PA. (Since the gap from the PA/NJ border to the next EV station in Springfield, NJ is greater than 50 miles, it would make more sense, in the short-term, for a new EV station to be deployed in NJ, rather than along the 10-mile "Pending" stretch from Bethlehem to the NJ border).

TABLE 21: Deployment Scenario 1: Fill Gaps (3 New Stations)

Deployment Role	Rt.	Exit	Sites for Potential Station(s) (Miles from Exit)
Existing Station: Hagerstown, MD	I-81	6 (MD)	
Gap 1: MD to Carlisle	I-81	14	Sheetz (<1), Dunkin (<1), Weis (<1), Wendy's (<1), Arby's (<1), Giant (<1), Shopping Mall (<1)
		16*	Sheetz (<1), Shopping Mall (<1), Nissan (<1), Harley-Davidson (<1), Battery Warehouse (<1), Dunkin (1), Walmart (1.8)
		17	Sheetz (<1), Shopping Mall (<1), Giant (<1), Target (<1), Aldi (<1)
Existing Station: Carlisle, PA	I-81	52	
Gap 2: Carlisle to Bethlehem, West	I-81	72*	Sheetz (<1), Dunkin (<1), Harley-Davidson (<1), Wendy's (2), Arby's (2), Shopping Mall (2)
		77	Sheetz (<1), Travel Centers of America (<1), FlyingJ Travel Center (<1), Pilot Travel Center (<1)
Gap 3: Carlisle to Bethlehem, East	I-78	13	Sheetz (<1)
	I-78	23	Love's (<1), Dunkin (<1)
	I-78	29*	Rutter's (<1), Dunkin (1), Wendy's (1), Walmart (1.3), Wawa (1.3), Arby's (2)
Existing Station: Allentown, PA	I-78	51/53	
Existing Station: Bethlehem, PA	I-78	67	
Gap to NJ station (53 mi. from PA border) unable to be filled in PA			
Existing Station: Springfield, NJ	I-78	49 (NJ)	

*Top-ranked exit within deployment role

As indicated in the table, each of the three proposed locations – (a) I-81 Exit 14, 16, or 17 in Chambersburg, PA; (b) I-81 Exit 72 or 77 in Harrisburg, PA; and (c) I-78 Exits 13, 23, and 29 in Berks County – include a sample of several different options for specific sites. Most of these specific sites identified are within 1 mile of the nearest exit, and all are within 2 miles. (Note that this is just a sample of potential sites; to be clear, any business at these locations that are interested in hosting an AFC station would also be considered a potential site). As denoted by the asterisk, the optimal deployment scenario, according to the results of the exit prioritization analysis, would be to deploy new stations at each of I-81 Exit 16, I-81 Exit 72, and I-78 Exit 29.

Figure 16 is an aerial of the top-ranked exit within the first proposed location, I-81 Exit 16, and shows the variety of commercial land uses in its immediate vicinity. As indicated in the map, there are a number of potentially viable site alternatives for a new EV station, including; a Sheetz service station; a Dunkin; a shopping mall (Franklin Center); a Battery Warehouse for Electric Motors; auto dealerships such as Harley-Davidson, Nissan, and Honda; and about 1-mile to the east of the image along Lincoln Hwy, a Walmart. In addition, 1 mile up the interstate, off I-81 Exit 17, there is a shopping center (Chambersburg Crossing) that includes several businesses that could potentially support DC fast charging, including Sheetz, Giant, Aldi, and Target. A station at this location would fill the 60-mile gap between the existing EV AFC stations in Hagerstown, MD and Carlisle, PA.

FIGURE 16: I-81 Exit 16 Aerial Imagery (Google Earth)

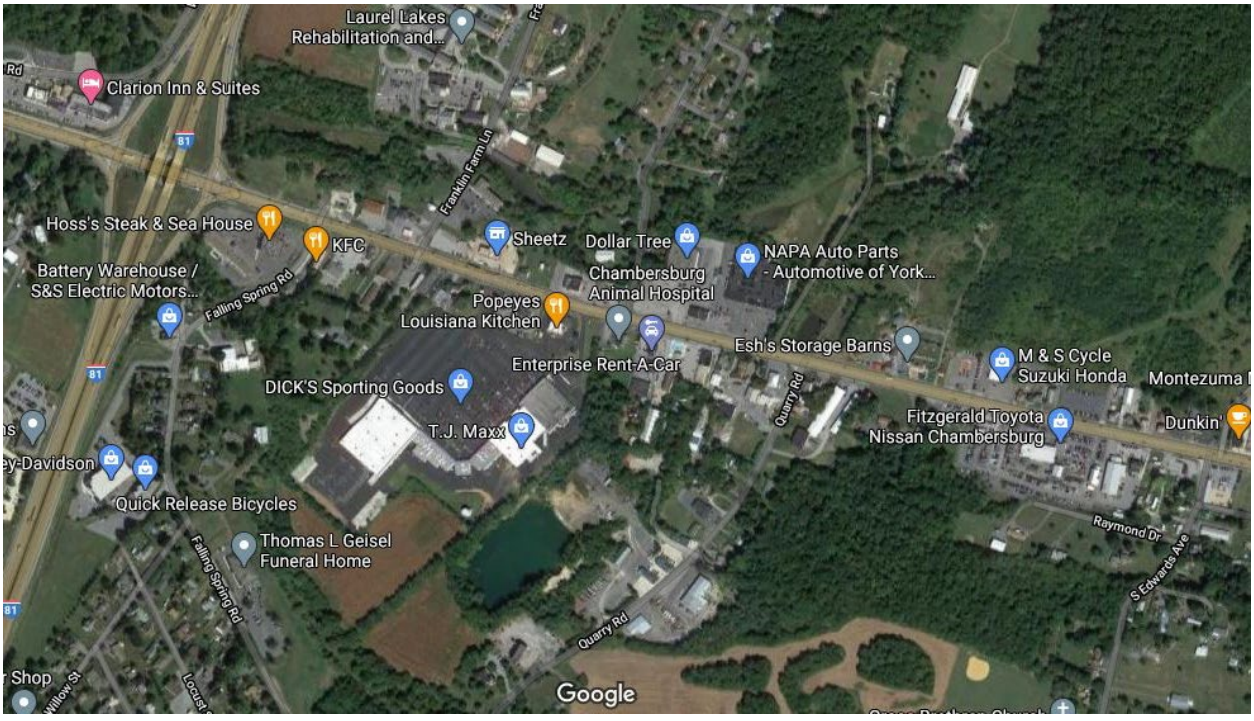


Figure 17 and **Figure 18** provide aerials of the top-ranked exits at the other two priority locations, I-81 Exit 72 and I-78 Exit 29. A new station at each of these two locations would fill the 95-mile gap between the existing EV AFC stations in Carlisle, PA and Allentown, PA.

FIGURE 17: I-81 Exit 72 Aerial Imagery (Google Earth)

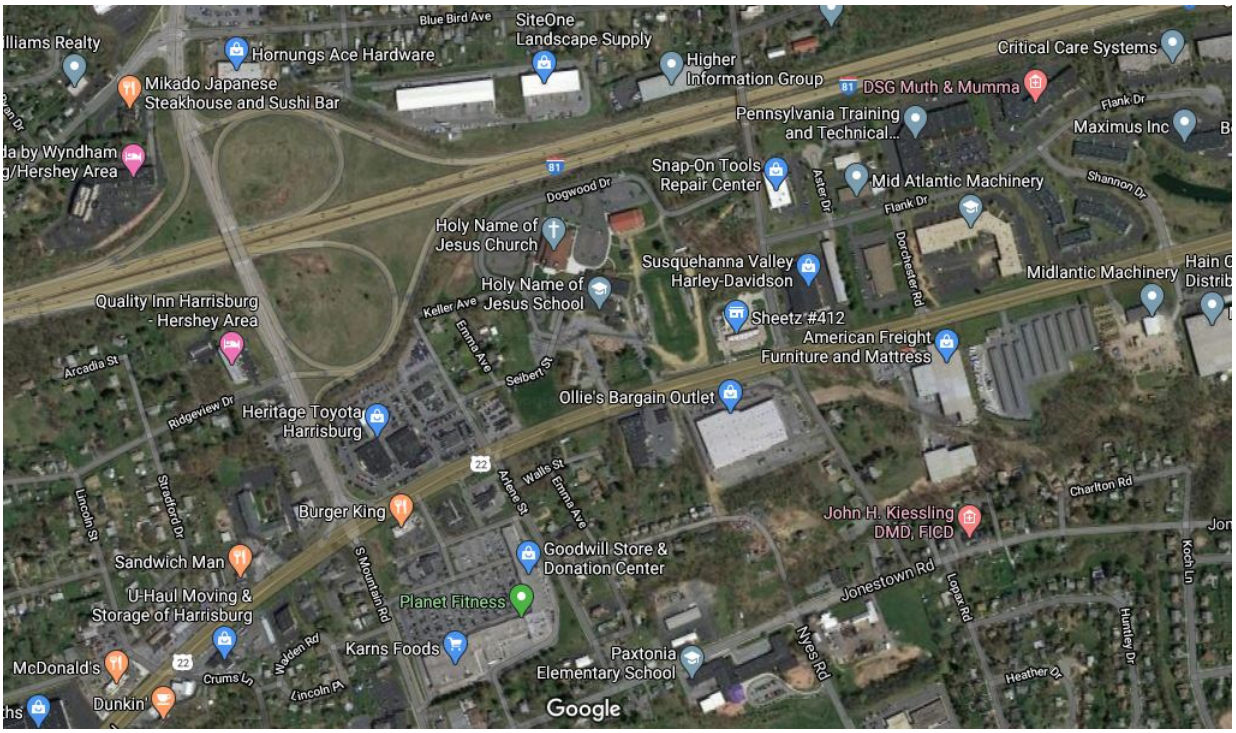


FIGURE 18: I-78 Exit 29 Aerial Imagery (Google Earth)

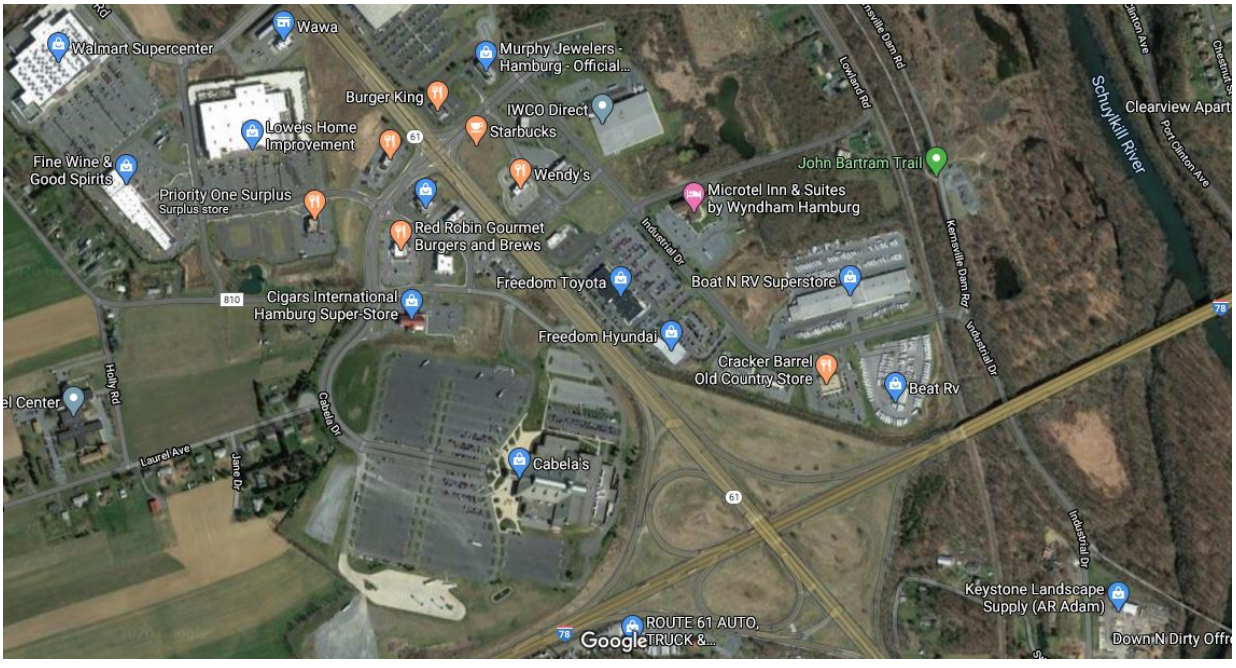


Figure 19 shows the distances between existing stations and proposed locations for new stations, as identified in the "Fill Gaps" scenario. Distances are approximated due to the range of potential sites that exist as options within each prioritized exit location. In all cases, distances between stations would be reduced to within the 50-mile FHWA-required threshold and would make the corridor eligible to be designated for "Ready" status for 156 out of 166 miles of its entire length, from the MD state line to the existing station in Bethlehem, PA.

FIGURE 19: Deployment Scenario 1: Fill Gaps (3 New Stations)

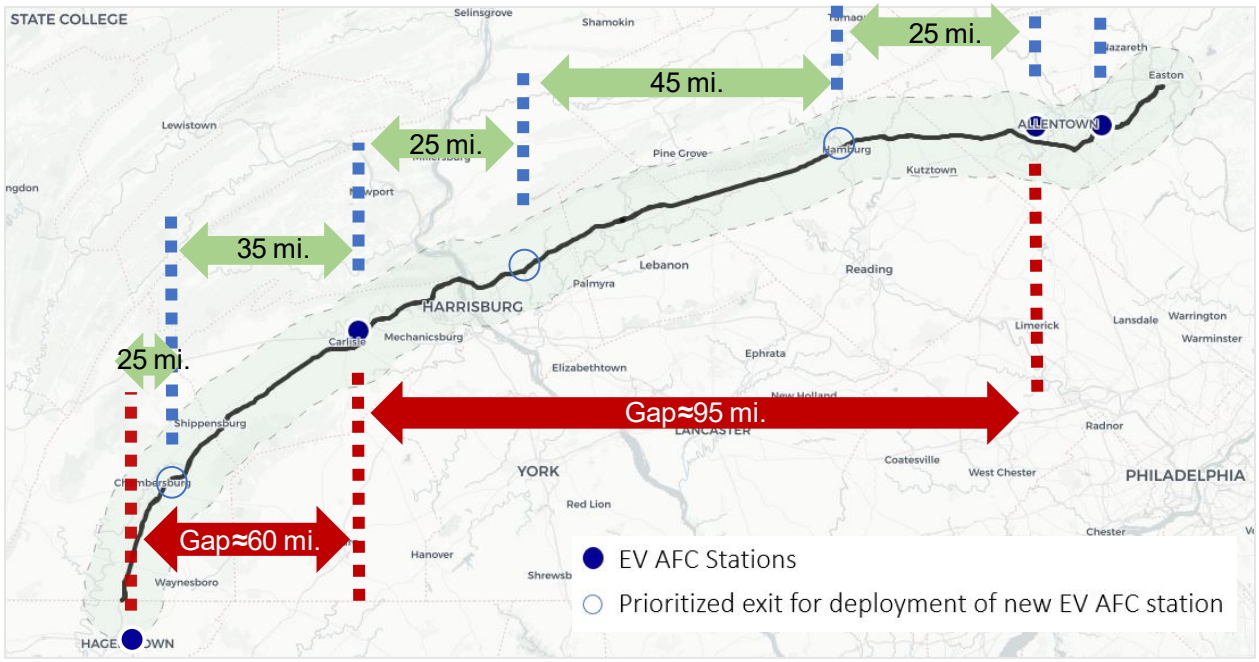


Table 22 provides a slightly longer-term (3-5 years) scenario for EVs, in which the three locations identified in the "Fill Gaps" scenario are supported by four additional stations. These include: a) a station within 1 mile of the interstate that can serve as an alternative to the existing Carlisle station that is 2.5 miles off the interstate; b) a station that would shorten the distances between the proposed "Fill Gap" stations in Harrisburg (I-81 Exit 72 or 77) and Hamburg (I-78 Exit 29), a gap that would be otherwise, depending on station siting, 46-49 miles apart; (c) a station that can serve as an alternative to the existing Allentown and Bethlehem stations, the latter of which is 3.5 miles off the interstate, has only one charger, and is not near any public commercial amenities; and (d) a station near the PA/NJ border (I-78 Exit 75) that would upgrade the PA corridor to "Ready" for its final 10 miles, from Bethlehem to NJ. Note that while I-81 Exit 70 scored the highest among exit locations that could serve as alternatives to the Carlisle station, there is a lack of potential sites closer than 2 miles of the interstate. Since one of the main purposes of deploying an alternative to the Carlisle station is to provide a station that is closer to the interstate, I-81 Exits 44, 45, 47, 48/49, and 69 – which each have potential sites within 1 mile of the exit – could all just as arguably be better locations for a new station than I-81 Exit 70.

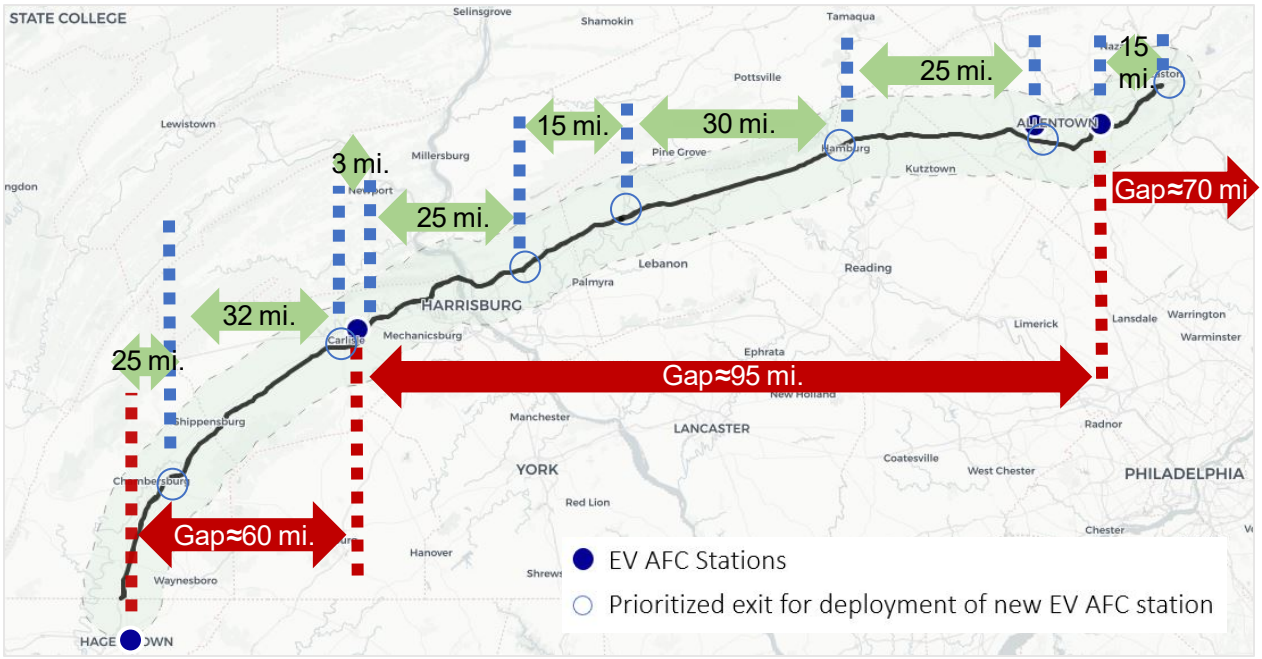
Figure 20 shows how new stations could be deployed for this more "Aggressive Deployment" scenario.

TABLE 22: Deployment Scenario 2: Aggressive Deployment (7 New Stations)

Deployment Role	Route	Exit	Sites for Potential Station(s) (Miles from Exit)
Existing Station: Hagerstown, MD	I-81 (MD)	6 (MD)	
1 – Gap 1: MD to Carlisle	I-81	14	Sheetz (<1), Dunkin (<1), Weis (<1), Wendy's (<1), Arby's (<1), Giant (<1), Shopping Mall (<1)
		16*	Sheetz (<1), Shopping Mall (<1), Nissan (<1), Harley-Davidson (<1), Battery Warehouse (<1), Dunkin (1), Walmart (1.8)
		17	Sheetz (<1), Shopping Mall (<1), Giant (<1), Target (<1), Aldi (<1)
2 – Carlisle Station Alternative	I-81	44	Sheetz (<1)
		45	Giant (<1), Shopping Mall (<1)
		47	Walmart (<1)
		48/49	Sheetz (<1), Shopping Mall (<1)
		69	Shopping Mall (<1), Dunkin (<1), Turkey Hill (<1)
		70*	None within 1 mile; Shopping Mall (2), Dunkin (2), Shopping Mall (2.5), Sheetz (3), Arby's (3), Wendy's (3)
Existing Station: Carlisle, PA	I-81	52	
3 – Gap 2: Carlisle to Bethlehem, West	I-81	72*	Sheetz (<1), Dunkin (<1), Harley-Davidson (<1), Wendy's (2), Arby's (2), Shopping Mall (2)
		77	Sheetz (<1), Travel Centers of America (<1), Flying J Travel Center (<1), Pilot Travel Center (<1)
4 – Other: Shortens distances between	Int	90/1*	Dunkin/Speedway (<1), Love's Travel Stop (<1)
	I-78	10	Flying J Travel Center (<1)
5 – Gap 3: Carlisle to Bethlehem, East	I-78	13	Sheetz (<1), Valero Gas (<1)
	I-78	23	Love's (<1), Dunkin (<1)
	I-78	29*	Rutter's (<1), Dunkin (1), Wendy's (1), Walmart (1.3), Wawa (1.3), Arby's (2)
Existing Station: Allentown, PA	I-78	51/53	
6 – Allentown-Bethlehem Station Alternative	I-78	49	Dunkin/Shell (<1), Wawa (1), Weis (1.3), Shopping Mall (1.3)
	I-78	54*	Dunkin (<1), Various Auto (<1), Dunkin (1), Weis (1.5), Wendy's (1), Wawa (1.2), Costco (1.2), Shopping Mall (1.5), Giant (2.5), Walmart (3)
	I-78	57	Dunkin (<1), Giant (1), Shopping Mall (1), Various Auto (1-2)
Existing Station: Bethlehem, PA	I-78	67	
7 – Other: Fills gap to NJ state line	I-78	75*	Dunkin (<1), Turkey Hill (<1)
Gap to NJ station (53 mi. from PA border) unable to be filled in PA			
Existing Station: Springfield, NJ	I-78 (NJ)	49 (NJ)	

*Top-ranked exit within deployment role

FIGURE 20: Deployment Scenario 2: Aggressive Deployment (7 New Stations)



Exploring Other Scenarios

It must be noted that there is a third scenario that would fill the 95-mile EV AFC gap from Carlisle to Allentown with a single station, at either I-78 Exit 6 EB/8 WB or I-78 Exit 10. If located just off the interstate (<1 mi.), a new station at I-78 Exit 6/8 would be about 45 miles from the Carlisle station and just under 50 miles from the planned Allentown station; a new station at I-78 Exit 10 just off the interstate (<1 mi.) would be just under 50 miles from the Carlisle station and about 45 miles from the Allentown station. At either exit location, the new station would have to be deployed at a site that is very close to the interstate for the distances to the next station along the corridor in either direction to be within the FHWA-required 50 miles. One potential site is a travel center at I-78 Exit 10 that provides both food and gas. **Figure 21** provides an aerial of I-78 Exit 10.

A new station here would instantly upgrade the I-81/I-78 PA corridor to "Ready" from Carlisle to Bethlehem. However, while this seems like the most efficient way to upgrade the corridor, it may not be the quickest. Based on the business models and network partnerships that are employed currently by the existing EV DC fast stations in PA, it seems exceedingly more likely that a property owner and/or EV network company would be interested in deploying a new station in areas with higher traffic volume, greater job and/or population density, and surrounded by more amenities. This is because, importantly, efficiency in this context does not mean less stations: if one station off I-78 Exit 10 is deployed to fill the Carlisle-Allentown gap on its own, it does not follow that it would generate more charging activity than two new stations (e.g. I-81 Exit 72 and I-78 Exit 29) deployed to fill the same gap. As a long-term tactic, it is more efficient to deploy new stations in a manner that balances not only the FHWA distance requirements (stations <50 miles), but also the interests of the business community to invest in locations that generate a high amount of activity.

FIGURE 21: I-78 Exit 10 Aerial Imagery (Google Earth)

One additional consideration that PennDOT is keeping an eye on is the 50-mile FHWA-requirement for AFC stations along a "Ready" corridor. On one hand, as driver demand increases, this distance requirement could become stricter (for example, decreased to 25 miles); on the other hand, as EV technology increases in the coming decade (such as battery efficiency and capacity) the FHWA could also provide more flexibility, particularly in rural areas, for greater distances between stations (for example, 75 miles). This latter possibility is especially worth monitoring; as noted earlier (see section *Key Partners for Implementing New Infrastructure*), the EV network company Electrify America – whose investment plans must be approved by the U.S. Environmental Protection Agency (EPA) – uses 70 miles as a target distance between stations along corridors. Should the FHWA, in the future, increase the distance requirement between EV AFC stations from 50 miles to 70 miles or even 75 miles, then one new station at the priority exit location in Harrisburg, PA (I-81 Exit 72-77), depending on the distance of the site from the interstate, could fill the gap between the existing EV AFC Carlisle and Allentown stations on its own.

Funding Opportunities

Evaluation of Grants and Other Funding Opportunities

- Driving PA Forward
- PADEP Alternative Fuel Incentive Grant (AFIG) and Other Programs
- PennDOT P3 Program
- Utility Programs

Funding Opportunities

A key component of implementing the Deployment Plan is to make use of existing programs and opportunities that serve to facilitate the development of new alternative fuel stations. These include state incentive programs such as the Driving PA Forward program and the Alternative Fuel Incentive Grant (AFIG) program, private-public partnership (P3) opportunities with infrastructure providers and operators, and utility company programs. The following section provides an overview of the various programs and opportunities that may be leveraged to strategically deploy new alternative fuel stations along the corridor.

Driving PA Forward

The Driving PA Forward initiative is a set of alternative fuel grant and rebate programs established under current Pennsylvania Governor Tom Wolf and administered by the PA Department of Environmental Protection (DEP). The goal of the initiative is to reduce NOx emissions by 27,000 tons. These programs include: the Class 8 Truck And Transit Bus Grant Program; the Onroad Rebate Program; the Ocean Vessel Shorepower Grant Program; the Electric Cargo Handling Grant Program; the Marine and Rail Freight Movers Grant Program; the PA State Clean Diesel Grant Program (DERA); the DC Fast Charging and Hydrogen Fueling Grant Program; and the Level 2 EV Charging Rebate Program.

The **DC Fast Charging and Hydrogen Fueling Grant Program** – the grant opportunity most relevant to the priorities of this Deployment Plan – will allocate $10 million in reimbursement grants over a 5-year period for the "acquisition, installation, operation and maintenance of electric vehicle (EV) fast charging equipment and hydrogen fuel cell vehicle supply equipment."[33] The 2021 application cycle is expected to open in late spring/summer 2021. During the 2020 cycle, for DC fast projects, the program offered reimbursements of up to 70% of the total project cost with a maximum award of $250,000. This application cycle opened on July 2, 2020, with two submission deadlines: September 4, 2020; and February 26, 2021. The nature of the reimbursement grant is such that grantees are required to pay all upfront costs and submit invoice documentation to PA DEP in requesting reimbursement. Eligible applicants, according to the 2020 Program Guidelines, included: businesses incorporated or registered with the PA Department of State; incorporated nonprofits; state, local, or tribal government agencies; air quality or transportation organizations; Metropolitan or Rural/Regional Transportation Planning Organizations; and federal government agencies.[34] In scoring applications during the 2020 cycle, DEP favored projects in one, two, or all of three prioritized locations:

- Within one of the six major PA metropolitan statistical areas (MSAs) (encompassing the cities of Philadelphia, Pittsburgh, Allentown, Harrisburg, Lancaster, Scranton)
- Within 3 miles of an interstate
- Within 5 miles of an interstate and more than 25 miles from the nearest alternative fuel station of the same fuel type (DC fast or hydrogen)

Additional points were awarded to applications that included a Site Host Agreement or similar written agreement between the property owner and any third-party station operator or network. The

[33] PA DEP, Driving PA Forward, http://www.depgis.state.pa.us/DrivingPAForward/
[34] PA DEP, DC Fast Charging and Hydrogen Fueling Grant Program Guidelines, 2020, http://www.depgis.state.pa.us/DrivingPAForward/pdfs/CY2020%20DCFC%20H2%20Program%20Guidelines.pdf

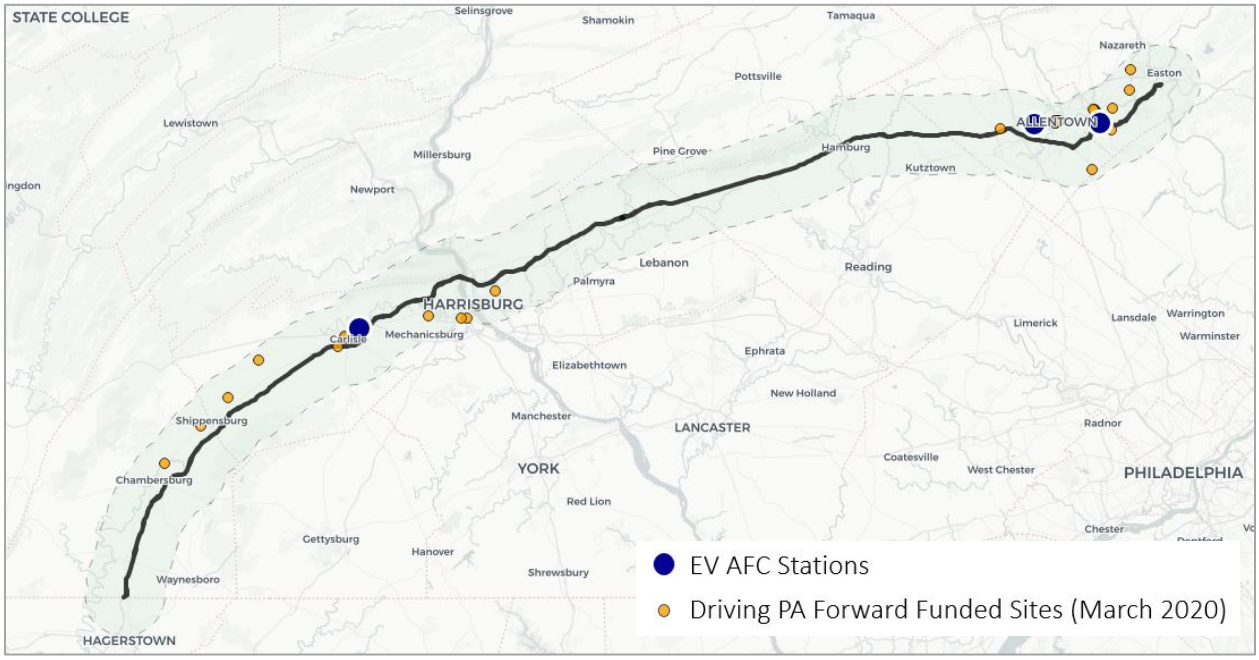
application also required a detailed budget breakdown for project design and engineering, equipment purchase, installation, third-party operator/network fees and expenses, operation and maintenance for up to 3 years, and documentation providing the basis of all costs. All DC fast projects were required to have had a minimum of two connectors, each consisting of both CHAdeMO and CCS connector types with at least one of the two connectors charging at 150 kW or greater.

About $2 million is awarded each cycle. During the first part of the previous cycle (CY2018-2019), DEP awarded funding to the following five recipients totaling $1,244,316 (none on the I-81/I-78 PA corridor):

- Giant Eagle Inc. - $240,000 – Purchase and install 2 DC fast chargers – Allegheny County
- ChargePoint, Inc. - $264,475 – Purchase and install 2 DC fast chargers and 2 Level 2 EV chargers – Philadelphia County
- Giant Eagle Inc. - $240,000 – Purchase and install 2 DC fast chargers – Allegheny County
- ChargePoint Inc. - $254,191 – Purchase and install 2 DC fast chargers – Bucks County
- City of Pittsburgh - $245,650 – Purchase and install 4 DC fast Chargers and 8 Level 2 EV chargers – Allegheny County

Another Driving PA Forward program is the **Level 2 EV Charging Rebate**, which will allocate $7.7 million in rebates over a 5-year period, on a first-come, first-serve basis. The maximum reimbursement for a public networked Level 2 charging project on private property is $4,000 per plug, or 70% of the project cost. On government property, the reimbursement is $4,000 per plug, or 80% of the project cost. **Figure 22** shows the Driving PA Forward Funded sites along the corridor, as of March 2020. All Driving PA Forward sites along the corridor are Level 2 EV Charging Rebate projects. For more information on the Driving PA Forward projects along the corridor including project status and recipient organizations, see Appendix **Tables M and N**.

FIGURE 22: Driving PA Forward Funded Sites, I-81/I-78 PA Corridor



PADEP Alternative Fuel Incentive Grant (AFIG) and Other Programs

The PA DEP Alternative Fuel Incentive Grant (AFIG) program, established in 1992 and expanded in 2004 under the Alternative Fuels Incentive Act, makes approximately $6 million in grants available each year for: retrofitting vehicles to operate on alternative fuels; purchasing alternative fuel vehicles; purchasing and installing alternative fuel infrastructure; and/or conducting research, training, development, and/or demonstrating new applications or next-phase technology related to alternative fuel vehicles. During the 2020 cycle, PA DEP awarded $3.4 million to 20 projects, including one new DC fast station: $149,849 to install two DC fast chargers for EVs for public use at a Country Fair service station in Edinboro, PA, off I-79.[35] For the full list of 2020 AFIG awardees announced in May 2021, see Appendix **Table O**.

In recent years, PA DEP has expanded its alternative fuel incentivization efforts through the administration of several additional programs. The **FAST Act Corridor Infrastructure Grant** – which after the 2020 cycle was replaced by the Public Refueling portion of the Refueling Infrastructure grants in the 2020 AFIG solicitation – was established as a result of the federal Fixing America's Surface Transportation Act of 2015, from which the FHWA's AFC program originates (FAST Act Section 1413). It allocated about $1 million per cycle to install public alternative fuel infrastructure along PA highways that had been formally designated as "Ready" or "Pending" alternative fuel corridors through the FHWA's nomination process. Grants provided up to a 50% reimbursement or up to $500,000. During the last application period (January – March 2020), the program awarded six grants totaling $608,216.[36]

The **Alternate Fuels Technical Assistance (AFTA)** program is not a grant or rebate program, but rather, provides technical assistance to Pennsylvania organizations that typically manage fleets, such as political subdivisions, nonprofits, municipal authorities, and school districts. Through the AFTA program, DEP assigns a professional consulting firm to work directly with the selected organization "for the purpose of developing technically viable and economically sustainable alternative fueling strategies."[37] Recipient organizations in the first two rounds of the program have included: ALCOSAN; Capital Region Water; Central Bucks Emergency Medical Service; City of Philadelphia; Community Transport of Delaware County; Indiana Borough; Kennett Square Borough; Lower Merion Township; Pittsburgh Public Schools; and Suburban Transit Network. While the AFTA program is not currently accepting new applications, eligible organizations seeking technical assistance are encouraged to view previously completed AFTA reports that are made available on the AFIG program website and may serve as useful resources.

The **Alternative Fuel Vehicle (AFV)** program offers rebates on alternative fuel vehicle purchases to individual state residents (as opposed to public agencies, businesses, or nonprofit organizations) on a first-come, first-serve basis. Individuals must apply within six months of vehicle purchase. New, pre-owned, and demonstration vehicles under $50,000 are eligible. Rebates include: $1,000 for hydrogen fuel cell vehicles; $750 for battery EVs; and $500 for plug-in hybrid EVs, CNG vehicles, propane vehicles, or electric motorcycles. Low-income applicants are eligible for an additional $1,000.

PennDOT P3 Program

In 2016, PennDOT entered a public-private partnership (P3) with Trillium to "design, build, finance, operate, and maintain" CNG stations for public transportation agency fleets throughout the state. In

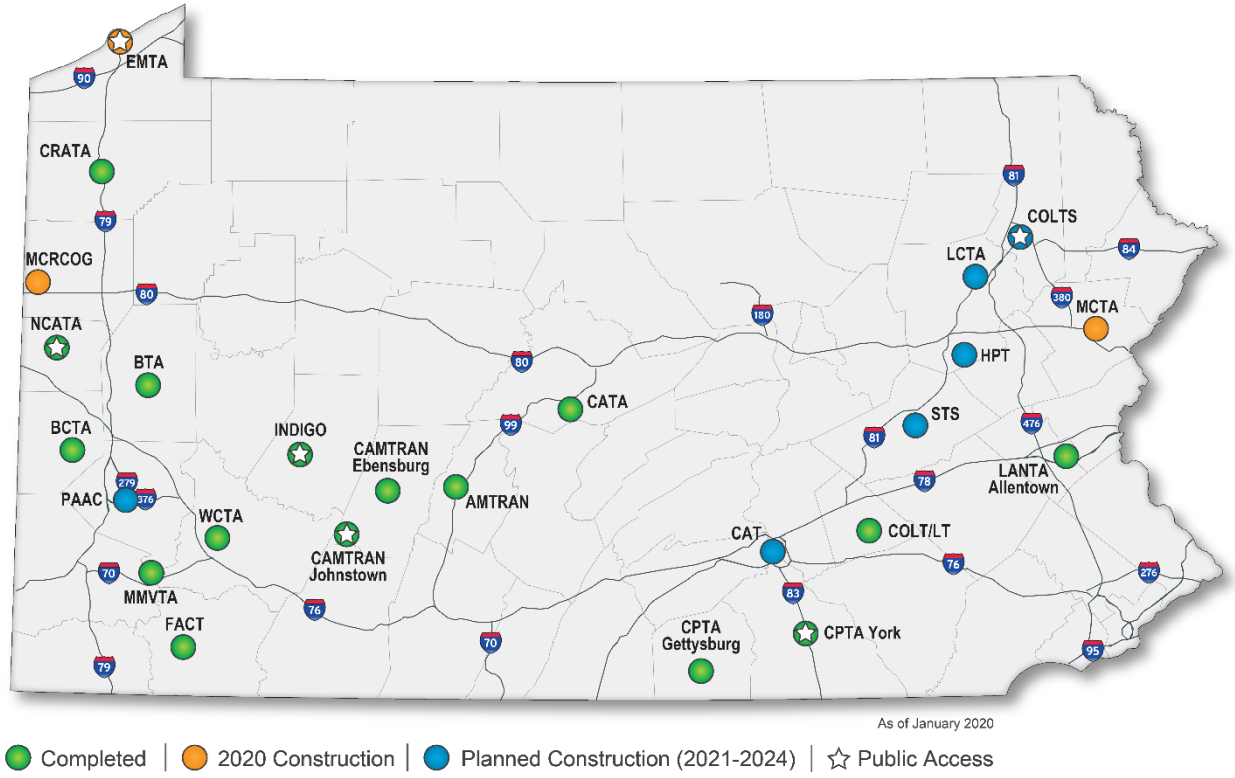
[35] PA DEP, DEP Newsroom, 2021, https://www.ahs.dep.pa.gov/NewsRoomPublic/articleviewer.aspx?id=21953&typeid=1
[36] PA DEP, 2020, 2019-2020 AFIG Annual Report
[37] PA DEP, Alternative Fuels Incentive Grant (AFIG) Program, https://www.dep.pa.gov/Citizens/GrantsLoansRebates/Alternative-Fuels-Incentive-Grant/pages/default.aspx

total, the Trillium stations developed under the 20-year, $84.5 million P3 agreement are expected to provide fuel to over 1,600 buses at 25 different sites.[38] Using the P3 procurement mechanism allows PennDOT to install the fueling stations faster than if a traditional procurement mechanism were used for each site resulting in significant estimated capital cost savings. Moreover, compressed natural gas is cheaper per gallon than conventional gas and diesel fuel, and burns cleaner, extending engine life. This makes transit agencies more sustainable economically – less dependent on state funding – and environmentally, lowering carbon emissions.

The Trillium P3 stations may be located in fleet garages or as standalone stations on public property. An increasing number of stations have been made publicly accessible, including (recently) the Trillium CNG station at the Lehigh and Northampton Transportation Authority (LANTA) fleet garage along the corridor in Allentown, 2 miles off I-78 Exit 57. A second CNG transit station is planned along the corridor for Capital Area Transit (CAT) in Harrisburg, off I-81 Exit 69.

Figure 23 shows the CNG stations used by transit fleets across the state, as of January 2020.

FIGURE 23: Compressed Natural Gas (CNG) Transit Fueling Stations, PA



Due to the success of the P3 CNG program, PennDOT may also consider in the near future the use of a P3 agreement for EV charging.

[38] https://www.penndot.gov/ProjectAndPrograms/p3forpa/Pages/CNG-Fueling-Stations.aspx

Utility Programs

With the electrification of the transportation sector underway and expected to accelerate this decade, the electric utility industry has the potential to benefit tremendously. Some utility companies, to help facilitate this transition, have begun offering incentives to drivers and property owners, including in PA.

PECO, which serves the greater Philadelphia region, has begun a pilot project that offers a discount on electric utility distribution charges for commercial properties that install EV DC fast infrastructure. The PECO pilot program, available from July 1, 2019 to June 20, 2024, offers a 50% discount on distribution charges for DC fast stations serving the public or workplace fleets.[39] The pilot program complements PECO's other EV customer incentives, including rebates of $500 to commercial customers who install Level 2 chargers, and $50 to customers who purchase an electric vehicle. According to PECO, greater EV use could result in an estimated $2.8 billion in benefits for Pennsylvania.[40]

Duquesne Light Company (DLC), which operates out of Pittsburgh, offers customers who purchase an all-new electric vehicle at select dealerships a Duquesne Light EV Rebate of up to $2,000.[41]

The electric utility companies along the corridor – *West Penn*, *Met-Ed*, and *PPL* – do not currently offer financial incentives for EV drivers or station hosts, however West Penn and Met-Ed (both subsidiaries of First Energy) each have a number of other incentive and rebate programs, and PPL made commitments towards EV adaptation, including a three-year research project in partnership with General Motors and the Electric Power Research Institute and adding 15 new EVs to their business fleet in 2015. These programs are encouraging and will need to be built on for the further facilitation of DC fast stations in the immediate future.

Additional Federal Funding Sources for Electric Vehicle Charging Infrastructure

On April 22, 2021, FHWA released a document providing several DOT funding and finance programs that are available to plan for and build EV chargers; support workforce training for new technologies, and integrate EVs as part of strategies to address commuter, freight, and public transportation needs.[42] The document highlights eligibilities under each of the programs. FHWA is encouraging transportation partners to use existing DOT funding and finance programs to build out EV charging, as well as to use these programs to leverage private sector investment in such a national EV charging network. This report can be found at the following link: https://www.fhwa.dot.gov/environment/alternative_fuel_corridors/resources/ev_funding_report_2021.pdf.

FHWA's EV Charging Funding report is a comprehensive resource of available funding sources

As many of the programs highlighted by FHWA are oversubscribed with other eligible project types, PennDOT may focus future opportunities within its CMAQ program. This program has been enhanced to provide a more active role for the state's regional planning partners in project selection. CMAQ project goals focus on air quality improvements, and EV charging opportunities will be highlighted as a potential project type for consideration. For more information on how CMAQ funding can support AFC planning, reference FHWA's fact sheet: https://www.fhwa.dot.gov/environment/air_quality/cmaq/reference/altfuel_factsheet.cfm.

[39] PECO, https://www.peco.com/SiteCollectionDocuments/EVFastChargerPilotDiscountRates.pdf
[40] Ibid.
[41] U.S. Department of Energy, Alternative Fuels Data Center, https://afdc.energy.gov/laws/12491
[42] Federal Funding is Available for Electric Vehicle Charging Infrastructure On the National Highway System, FHWA, April 22, 2021.

Outreach & Implementation

An Approach for Facilitating the Deployment of New Stations through Stakeholder Outreach and Coordination

- Approach
- Stakeholder Outreach
- EV Network Companies
- Metropolitan Planning Organizations

Outreach & Implementation

Following the prioritization of locations for new AFC infrastructure, PennDOT reached out to key stakeholders (see section *Key Partners for Implementing New Infrastructure*) to discuss and establish a role that PennDOT could play in facilitating the deployment of new stations.

PennDOT began with sharing its findings with the *Pennsylvania Department of Environmental Protection (PA DEP)*, the state agency that currently administers grant programs for alternative fuel infrastructure, including DC fast charging. PennDOT and PA DEP discussed opportunities to: promote the 2020-2021 DC fast program application cycle to EV networks and businesses; and integrate Deployment Plan priority locations into future rounds of the DC fast program. Since a key takeaway from discussions with PA DEP was that both EV networks and businesses submit applications for the DC fast charging grant, it was important for PennDOT to develop a stakeholder outreach and implementation strategy that targeted both. **Figure 24** shows PennDOT's approach to generating DC fast charging grant applications from either EV network companies or businesses.

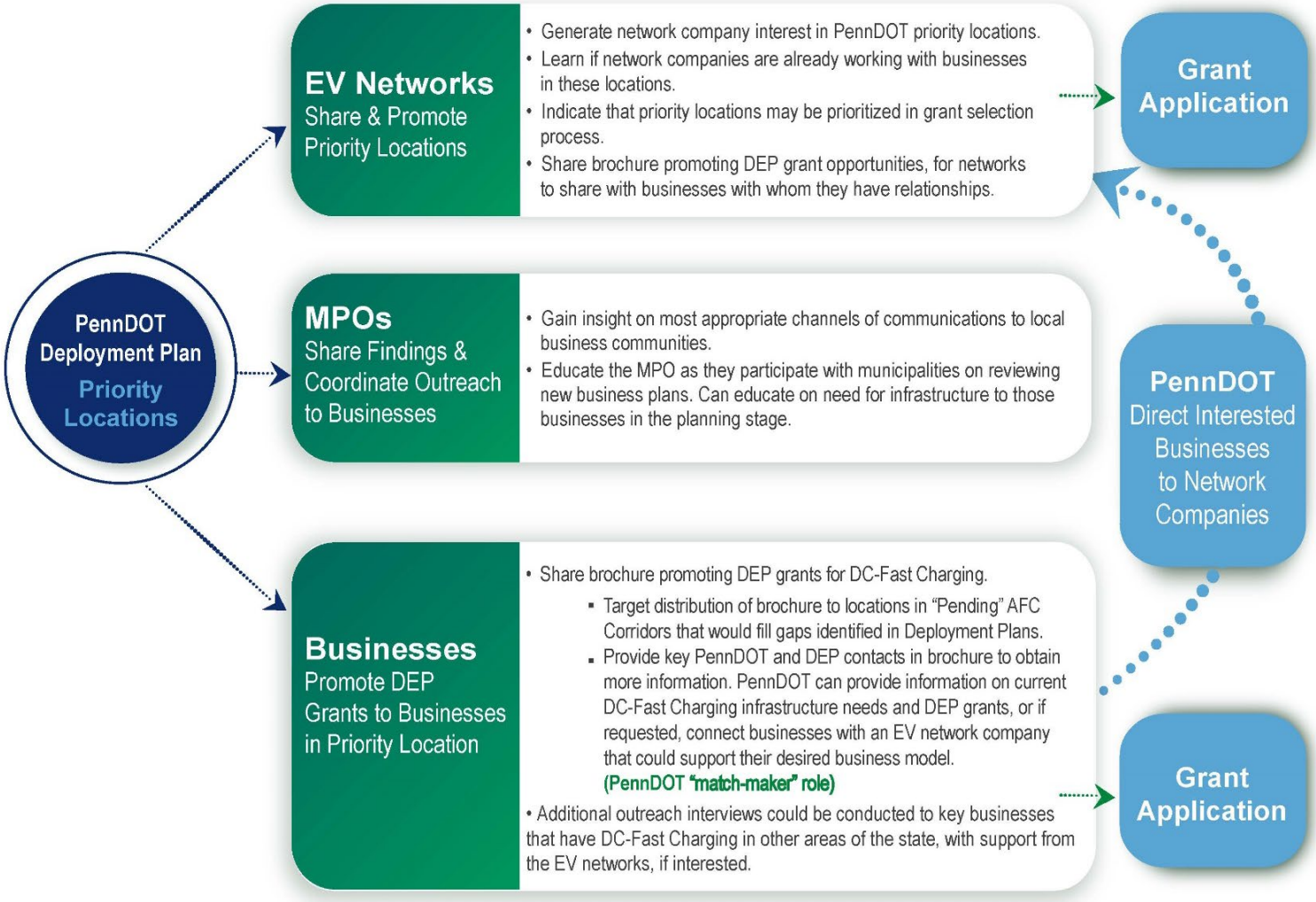
An equitable outreach approach to all businesses was an important goal of PennDOT's Deployment Plan

This approach is effectively twofold. The first approach is aimed at generating applications through the *EV network companies* by sharing Deployment Plan priority locations and a 1-page flyer promoting DC fast charging and the *Driving PA Forward* DC Fast-Charging grant. The network company can then share these materials with the businesses with which they have relationships or are in contact – particularly those businesses with sites at priority locations. The second approach is aimed at reaching all businesses, not only those that have existing relationships with EV network companies. This includes: coordinating with *metropolitan planning organizations (MPOs)* (and other planning partners, as appropriate) on the best ways to reach the local business communities at each of the priority exit locations; sharing the 1-page flyer on DC fast charging with *businesses at priority locations* through the MPO-recommended channels; and if needed, acting as a "match-maker" to connect interested businesses with an EV network company who may be interested in partnering with them on a *Driving PA Forward* DC Fast Charging grant application.

Figure 25 shows the 1-page flyer on DC fast charging that will be shared with EV networks and local businesses for the ultimate purpose of facilitating the deployment of a new station at the locations prioritized in this Deployment Plan. This 1-pager, titled *Electric Vehicle Fast-Charging FAQs & Funding Opportunities*, was developed by PennDOT specifically for use in implementing this Deployment Plan, with collaboration and support from PA DEP. While it is intentionally general enough to be used to promote DC fast charging anywhere in PA, it also includes a special call-to-action for interested businesses located specifically along the I-81/I-78 corridor.

After sharing the 1-pager with EV network companies and businesses, PennDOT will continue to conduct ongoing outreach to businesses and EV network companies. Upon contact from an interested business via the call-to-action in the 1-pager, PennDOT's process for acting as "match-maker" will be to reply with a survey form for the interested business to fill out, and based on the responses generated, may refer each business to the appropriate EV network company (or companies) as opportunities arise. This survey form can be accessed at https://www.surveymonkey.com/r/EVstation; its questions are included in this Deployment Plan for reference in **Figure 26**.

FIGURE 24: Approach to Facilitating Deployment of New Stations at Priority Locations



Stakeholder Outreach

It is important to note that the approach to implementation and ongoing outreach was not finalized early in the development of the Deployment Plan, but rather as a result of stakeholder outreach that included discussions with EV network companies and metropolitan planning organizations (MPOs). These discussions are described below.

EV Network Companies

During winter 2020-2021, PennDOT held discussions with each of the five EV network companies that currently operate public DC fast stations (CCS or CHAdeMO connector type) in PA: EVgo (18 stations in PA); Electrify America (10); Blink (9); ChargePoint (8); and Greenlots (1). The purpose of these initial discussions was to: provide background information on the FHWA AFC program and the I-81/I-78 Deployment Plan; share initial findings of the Deployment Plan including priority locations; learn more about the various business models of each EV network company including the nature of their partnerships with businesses hosting the station; and gain insight on what the EV charging industry

private sector views as best practices for state/federal funding programs and other EV-related public policies. The following are some of the key takeaways from the five (5) EV network company discussions:

EV Network Business Models

- The ***business models*** employed by EV network companies vary greatly, and not only from one company to the next. Rather, each EV network company itself may offer site hosts multiple business models.
- Aside from the ***ownership structures*** offered to site hosts, another factor distinguishing EV network companies is whether they provide charging hardware, software, or both.
- Two EV network companies that have similar business models in terms of ownership structure – EVgo and Electrify America, which both employ the ***network-owned model*** – are in fact very different in a fundamental way. EVgo's business model relies on generating profit from EV stations, which means identifying sites that are the most economically viable and/or applying for grant opportunities. Electrify America, on the other hand, is a heavily regulated company that is the result of a consent decree with Volkswagen and the US EPA related to the diesel emissions non-compliance issues. Since Electrify America is backed by Volkswagen investment, upfront costs are less of a barrier; as a result, they have a philosophy of overbuilding sites to have capacity for vehicles expected to be on the road in addition to vehicles currently on the road, and they do not apply as much for grant opportunities.
- The three EV network companies that employ the ***site-owned model*** – Blink, ChargePoint, and Greenlots – all differ from one another in various ways. For example, ChargePoint provides both hardware and software; Greenlots does not manufacture hardware themselves but instead has partnerships with providers of chargers that meet their open protocols (i.e. hardware that can be re-used if a site host wants to switch networks); and Blink, when applying for grant opportunities, pursues a network-owned model rather than the site-owned model it generally employs.
- Some EV network companies, such as Blink, ChargePoint, and Greenlots, offer ***charging "as a service***," as an alternative to the primary business model(s) they employ. In these arrangements, the network company installs and maintains ownership of the chargers minimizing upfront costs for the site host while still allowing the site host to operate and collect revenue from the station as if they owned it. In return, the site host pays the network company an annual subscription fee, which can be taken out of the revenue it collects.

EV Network Insight on Grant Applications

- Each of the five EV network companies commonly submit and/or assist businesses with ***grant applications*** for EV station projects. Electrify America, which has a fundamentally different business model in that it is backed by Volkswagen investment, is less reliant on this approach.
- EV network companies often establish ***partner/framework agreements*** with franchise businesses that have many locations, prior to determining any specific site. For example, an EV network company would first fill out an agreement with a franchise business's Real Estate Investment Trust (REIT); second, the EV network would hear from a state or entity that has a program covering an area that includes specific locations of that franchise; third, the EV network would propose to the REIT that they build an EV station on that specific property; and fourth,

the REIT will approve or forward the request to the franchise's regional manager or sustainability office.

- Building as much ***flexibility into grant programs*** as possible would encourage more applications. At times, stringent requirements can deter the most viable sites from applying. For example, a fueling station with six parking spaces that is required by the grant program to dedicate at least four spaces for charging will be discouraged from participating. Other deterrents cited included data-sharing requirements, low incentives that do not account for utility costs and demand charges, constrained geographical areas for stations, and aggressive timelines to deliver site host agreements. Florida's Volkswagen program was cited by multiple EV network companies as a best practice for balancing the need to create flexibility for EV network companies with the specific geographic goals of the FHWA AFC program.[43]

Other Key Findings from EV Network Discussions

- EV network companies often partner with each other on ***interoperability agreements***, allowing networks to exchange information, and drivers to charge seamlessly at stations operated by different networks. For example, a driver with the mobile app for charging at network A will be able to charge at a station operated by network B without having to download a new app.
- EV network companies can differ from ***EV charging services companies***, often collaborating on individual stations, with roles that can be fluid. For example, the network EVgo had several stations in PA operated by U-Go, a Philadelphia-based EV charging services company; however, when Blink acquired U-Go in fall 2020, the stations on the EVgo network were transitioned to the Blink network.[44]
- In comparing the ***CCS and CHAdeMO connector types***, the CCS chargers provide more capacity and have a significantly higher utilization rate. The CHAdeMO chargers are more of a "legacy" charger, as many of the car companies that have used it in the past have made their more recent models compatible with CCS in the United States. The expectation is that all EVs going forward will be CCS-enabled. However, for the time being, it is still important to have at least one CHAdeMO at each station, for drivers of older EV models, and for Tesla drivers, for which there is a Tesla-CHAdeMO adapter. There is a Tesla-CCS adapter in Europe, which uses CCS as the singular standard, but there is not one yet in the United States.
- Electric utility ***demand charges*** were consistently cited as the most significant regulatory barrier to the greater build-out of EV DC fast stations. In particular, multiple EV network companies cited a July 2019 white paper by the Great Plains Institute to better understand this issue.[45]
- The EV charging hardware company ***FreeWire*** – which initiated a discussion with PennDOT during the development of this Deployment Plan – bases its business model around mitigating the adverse impact of demand charges. It does this by using a battery-integrated fast-charger that can draw electricity from the grid at a smoother, less "peaky" rate, while still being able to fast-charge a vehicle at 120 kW. Additionally, because of the battery, FreeWire fast-chargers can be connected to the existing electrical grid, similarly to Level 2 chargers, without the construction costs and time typically associated with installing DC fast stations.

[43] Florida Department of Environmental Protection, https://floridadep.gov/air/air-director/content/demp-volkswagen-settlement-and-dera
[44] Globe Newswire, 2020, https://www.globenewswire.com/news-release/2020/11/24/2132918/0/en/Blink-Charging-Acquires-U-Go-Charging-and-its-Portfolio-of-EV-Charging-Stations.html
[45] Great Plains Institute, 2019, https://scripts.betterenergy.org/reports/GPI_DCFC_Analysis_July_2019.pdf

FIGURE 25: EV DC Fast-Charging FAQ & Funding Opportunities Fact Sheet for Businesses

pennsylvania
DEPARTMENT OF TRANSPORTATION

ELECTRIC VEHICLE FAST-CHARGING

FAQS & FUNDING OPPORTUNITIES

What Businesses Need to Know

What Is DC Fast Charging?

Direct current (DC) fast chargers are game-changers for electric vehicles (EVs). While many EV owners rely on home-charging overnight, **DC fast chargers can charge an EV in only 20 to 30 minutes.** In PA, over 80 locations – most of them businesses – currently have at least one DC fast charger installed in their parking lots.

Why Is Pennsylvania Investing?

One challenge to more rapid adoption of EVs is the lack of public DC fast chargers. By providing funding for fast charge projects in strategic locations – such as along highways and in underserved metro areas – Pennsylvania **aims to increase drivers' confidence in the availability of public EV chargers**, slow down climate change, and improve public health.

Which Businesses Are the Best Locations?

The best **types of businesses** for hosting DC fast chargers are restaurants, gas/convenience stores, truck stops, grocery stores, shopping centers, or any interested business with available parking spaces where an EV driver could shop and use amenities during the 20-30 min of charging time. Businesses that are 24/7 and offer food and restrooms are ideal. The best **locations for businesses** interested in hosting fast chargers are near interstate exits or in metro areas.

What Are the Benefits to Businesses?

- Attract customers looking to stop at a location that offers fast charging
- Increase customer spending at site amenities
- Minimize costs by choosing from a range of business models offered by EV charging hardware & network companies
- Gain customer recognition as a leader in reducing carbon emissions

Is Your Business Located On I-81/I-78?

The Pennsylvania Department of Transportation (PennDOT) is developing a Deployment Plan for alternative fuel infrastructure, including DC fast charging, along the I-81/I-78 corridor in PA. (plans for other interstates are anticipated in the future). If you are interested in a project consultation on fast-charging options and possible grant funding for a property located along the I-81/I-78 corridor, please contact:

RA-PDEVCorridors@pa.gov

DRIVING PA FORWARD

YOUR BUSINESS MAY BE ELIGIBLE FOR FUNDING

DC Fast Charging Grant Program

The Pennsylvania Department of Environmental Protection *Driving PA Forward* initiative includes reimbursements for the acquisition, installation, operation and maintenance of DC fast charging equipment. Program funding and eligibility details include:

- More than 1/2 of costs reimbursed for DC fast charging projects, or $250,000 maximum per award
- Projects must be in PA, publicly accessible, 24/7 operational, networked, and include both CCS and CHAdeMO connector types
- Preferred locations include projects off interstate exits (<5 miles) or in metro areas

Application Opens Early Summer 2021

Web Link:
Driving PA Forward Homepage

Scroll down to DC Fast Charging Grant Program to see Guidelines and Instructions

Pennsylvania is Committed to Supporting Growth in EV Vehicles. See the Pennsylvania EV Roadmap:
Web Link to Road Map

FIGURE 26: Survey Form for Business Interested in Hosting DC Fast Charging Stations

1. **Contact Information**
   Name: _____
   Site Name: _____
   Site Address: _____
   Email Address: _____
   Phone Number: _____

2. **Nearest interstate exit to site**: _____
3. **Distance from interstate exit (roadway miles)**
   a. Less than mile
   b. 1-2 miles
   c. 2-3 miles
   d. 3-5 miles
   e. Greater than 5 miles
4. **Type of Facility (Choose as many that apply)**
   a. Convenience
   b. Gas
   c. Grocery
   d. Hotel
   e. Restaurant
   f. Retail
   g. Other (please specify): _____
5. **Why are you interested in hosting electric vehicle fast charging on your site?**
   _____
6. **Are you interested in owning the electric vehicle charging equipment on site or having the equipment be owned by the charging company?**
   a. Your site owns and operates the charging equipment
   b. EV network company owns and operates the charging equipment
   c. Not sure
7. **Have you or your company previously worked with or contacted any EV network or infrastructure companies?**
   a. No, we have not
   b. Blink
   c. ChargePoint
   d. Electrify America
   e. EVGo
   f. Freewire
   g. Greenlots
   h. Not sure
   i. Other (please specify): _____

8. **Is the business located within Pennsylvania and publicly accessible?**
    a. Yes
    b. No
9. **Is the location accessible 24 hours per day, every day?**
    a. Yes
    b. No
10. **What are some of the amenities located within walking distance of the site? (E.g. grocery stores, shopping centers, restaurants, ATMs)**

    _____
11. **Does your site have the utility infrastructure to support DC fast charging?**
    a. Yes
    b. No
    c. Not sure
12. **Anything else to add?**

    _____

Metropolitan Planning Organizations (MPOs)

In January 2021, PennDOT held discussions with the *metropolitan planning organizations (MPOs)* that cover the priority locations for new EV stations along the corridor including: the Franklin County MPO for I-81 Exits 14-17; the Tri-County Regional Planning Commission (TCRPC) for I-81 Exits 72-77; and the Reading Area Transportation Study (RATS) for I-78 Exit 29. These discussions included an overview of FHWA AFC program, key findings of the I-81/I-78 Deployment Plan, potential sites for EV stations at the priority exits within each MPO's jurisdiction, and the MPOs' recommended channels of communication to local business communities.

Based on MPO feedback on priority locations, insight into outreach with local business communities, and questions about EV DC fast charging stations, PennDOT developed the 1-pager on *EV Fast-Charging FAQs & Funding Opportunities*, shown in **Figure 27**. In order to reach the businesses that are its primary audience, this 1-pager will be distributed to the MPOs and MPO-recommended municipalities and local business organizations in their jurisdiction with the view that any local-level outreach should be conducted through the guidance and established communications channels of PennDOT's local planning partners.

Additional Early Outreach

At the beginning of the project, in March 2020, PennDOT held a stakeholder meeting with the Drive Electric Pennsylvania Coalition to introduce the I-81/I-78 Deployment Plan and gather initial comments and questions. The Coalition, which was formed in 2016 in partnership with PA DEP, includes state and municipal government officials, Clean Cities Coalitions, EV businesses and consultants, transportation organizations, electric utilities, environmental groups, auto companies, individuals, and other interested stakeholders.

Conclusions & Lessons Learned

Key Findings and Next Steps

- AFC Infrastructure Priorities
- Lessons Learned
- Next Steps

Conclusions

AFC Infrastructure Priorities

There are four total gaps in alternative fuel corridor (AFC) infrastructure along the corridor that are currently designated as "Pending." As indicated in **Table 23**, PennDOT has identified the need for a total of ***three new EV stations***. This includes: one new EV station between the MD state line and the existing EV station in Carlisle, PA; and two new EV stations to fill the roughly 95-mile gap between the EV stations in Carlisle, PA and Allentown, PA. While one station located either at I-78 Exit 6/8 or I-78 Exit 10 could be sufficient in filling this latter gap, PennDOT determined that prioritizing two new stations for this gap would increase the range of exit locations that could be considered creating more flexibility and choices for identifying quality sites. The EV-"Pending" gap from Bethlehem, PA to Springfield, NJ, and the CNG-"Pending" gap from Carlisle, PA to Knoxville, TN, would be filled more efficiently distance-wise with new stations not in PA, but in NJ and MD, respectively.

TABLE 23: AFC Infrastructure Gaps and Needs, I-81/I-78 PA Corridor

AFC Type	From	To	Gap Distance in PA	New Stations Needed
EV "Pending" Gaps	I-81 Exit 6 (MD) Hagerstown, MD	I-81 Exit 52 Carlisle, PA	50 mi. (60 mi. to next station in MD)	1
	I-81 Exit 52 Carlisle, PA	I-78 Exit 51/53 Allentown, PA	95 mi.	1 (less flexibility) OR 2 (more flexibility)
	I-78 Exit 67 Bethlehem, PA	I-78 Exit 49 (NJ) Springfield, NJ	14 mi. (67 mi. to next station in NJ)	None in PA
CNG "Pending" Gap	I-40 Exit 385 (TN) Knoxville, TN	I-81 Exit 52 Carlisle, PA	52 mi. (530 mi. to next station in TN)	None in PA

To identify the best locations for the three EV stations needed, PennDOT conducted an analysis in two stages: 1) the prioritization of exit locations, based on a comparative data analysis of all 52 exit locations along the corridor; and 2) the identification of specific sites within each of the prioritized exit locations that could fit the business model for hosting a station.

The exit analysis (see section *Exit Prioritization Results*) resulted in the identification of three priority locations for new EV stations. The deployment of one new station at each of these locations would upgrade the I-81/I-78 PA corridor to EV-"Ready" for 156 miles out of its total length of 166 miles, from the MD border to Bethlehem, PA. These three priorities are:

1. **One new EV station at I-81 Exit 14, 16, or 17 in Chambersburg, PA**
2. **One new EV station at I-81 Exit 72 or 77 in Harrisburg, PA**
3. **One new EV station at I-78 Exit 29 in Hamburg, PA**

Following the exit analysis, the site evaluation identified specific businesses at the above priority locations, and others, that could potentially support a new EV station. As detailed in section *Deployment Scenarios*, PennDOT developed two scenarios for the deployment of new EV AFC infrastructure along

the corridor: 1) a short-term "Fill Gaps" scenario that focused on the three priority locations indicated above; and 2) a mid-term "Aggressive Deployment" scenario that aims to both fill existing gaps and provide additional stations at key exits in the Harrisburg-Carlisle and Allentown-Bethlehem-Easton metropolitan areas.

Lessons Learned

A key consideration guiding PennDOT's approach to this Deployment Plan is that it is a pilot study, one of the first five such plans to be commissioned by the FHWA in its inaugural round in 2019. Prior to this Deployment Plan, while PennDOT has participated in nominating corridors as "Ready" and "Pending" since the AFC program began in 2016, there was no formal role for PennDOT in facilitating the deployment of new stations at specific locations. Therefore, in addition to the main purpose of the study – identifying locations for new stations that would upgrade the corridor to "Ready" for EV and CNG – PennDOT also set the following goals, so that this document may be a resource for future Deployment Plans to follow:

- **Goal 1:** Demonstrate a ***data-driven approach*** to prioritizing locations for new infrastructure
- **Goal 2:** Establish a ***role for a DOT*** or MPO to play in planning and supporting future infrastructure
- **Goal 3:** Evaluate ***methods for equitable outreach***, including to businesses and to third-party infrastructure companies, regarding priority locations and existing state funding programs
- **Goal 4:** Understand the current ***business models*** for station hosts and third-party infrastructure companies
- **Goal 5:** Collaborate with administers of existing state ***funding programs*** to explore opportunities to incorporate Deployment Plan priorities into program application processes

The following are lessons learned for each of these five goals.

1. Using data to identify priority locations is an important step. It demonstrates to the stakeholders ultimately responsible for implementing the new stations – the EV network companies, the businesses, and the state grant program administers – that locations have been prioritized not merely to meet AFC distance gap requirements, but also because of their potential economic viability.
2. State and regional planning commissions may be able to play a role in facilitating AFC station deployment to fill corridor gaps, even without a dedicated fund for such infrastructure. Rather, the role PennDOT intends to play is to promote the existing state funding program administered by PA DEP to: a) the EV network companies operating in the state; and b) the business communities at Deployment Plan priority locations (see section *Outreach & Implementation*). Since EV network companies and individual businesses alike commonly apply for PA DEP funding, PennDOT is applying this dual approach, engaging both the EV networks and businesses simultaneously. If solicited by an interested business, PennDOT will play the role of a "match-maker," linking the business to the appropriate EV network companies that fits its desired business model. PennDOT will evaluate the effectiveness of this role for itself as implementation progresses following submission of this Deployment Plan.
3. The outreach that PennDOT conducted with EV network companies was an essential step to better understand the possible role that PennDOT could play in implementing the Deployment

Plan. EV network companies commonly apply to state funding programs, including PA DEP's DC fast program, and must be included on all applications since all projects in the program that receive funding must be networked. Since there are only a handful of EV network companies operating in PA and dozens (if not more) of viable sites for hosting DC fast charging, it was more efficient to hold individual discussions with each EV network company than with each individual potential site host. Furthermore, the EV network companies often already have existing agreements or relationships in place with at least one business at each priority exit location. Exploring these existing relationships is a logical step, but it is also important to recognize that smaller businesses are likely to be left out of the conversation and the opportunity if engaging solely with EV network companies. For a more equitable process, PennDOT and/or MPOs should conduct outreach more broadly to site owners and inform them of the business opportunity.

4. In understanding EV station business models – both from the perspective of the site owner and the EV network companies – PennDOT was able to: refine the data used to prioritize exit locations; inform the evaluation of specific sites at priority locations; establish the dual approach to outreach and implementation; and develop the 1-page *EV Fast-Charging FAQs & Funding Opportunities* flyer directed at businesses. During implementation, PennDOT will use its understanding of the EV network companies' business models to play a "match-maker" role in directing interested businesses to the EV network companies that fit their desired business model. In addition, the key takeaways from discussions with the EV network companies (see section *Stakeholder Outreach*) will inform future PennDOT AFC Deployment Plans and other policies related to EVs in the years ahead.
5. Without a dedicated fund for deploying new stations, PennDOT's approach to outreach and implementation centers around promoting the existing PA DEP grant for DC fast stations. For this reason, ongoing collaboration with PA DEP – administers of the state's existing grant program for DC fast stations – is critical. Early discussions with PA DEP were instrumental in alerting PennDOT to the significant role EV networks played in applying for grant opportunities and identifying opportunities to incorporate Deployment Plan priority locations in the next PA DEP grant application cycle. In subsequent discussions, PA DEP has also provided feedback on Deployment Plan drafts; PennDOT priority locations; PennDOT's outreach approach to EV networks and businesses; and the 1-page flyer on DC fast charging funding opportunities directed towards the business community.

Next Steps

Following submission of this Deployment Plan, and promotion of funding opportunities to the EV network companies, MPOs, and business communities at priority locations, the next steps for PennDOT are as follows:

1. Continue outreach to businesses
2. Maintain discussions and contacts with EV network companies to discuss priority locations and facilitate partnerships with interested businesses
3. Work with PA DEP on integrating Deployment Plan priority areas into EV fast-charging funding program application criteria
4. Monitor and gauge success in getting new infrastructure implemented on the I-81/I-78 corridor
5. Share efforts with MPOs throughout PA to gauge interest in future alternative fuel planning for other PA corridors

Appendix – Data Tables

Additional Data Tables Referenced in Study Report

Appendix

TABLE A: Public EV Charging Establishments in PA and the US, by Network

Network	Establishments Hosting DC Fast (DC Fast only)		Establishments Hosting Level 2 (Level 2 only)		Establishments Hosting Both DC Fast AND Level 2	
	PA	USA	PA	USA	PA	USA
Blink	9 (4)	67 (27)	41 (36)	1,133 (1,093)	5	40
ChargePoint	8 (6)	677 (434)	203 (201)	9,711 (9,468)	2	243
Electrify America	9 (9)	414 (320)	0 (0)	94 (0)	0	94
EVgo	18 (15)	788 (509)	3 (0)	301 (22)	3	279
Greenlots	1 (0)	165 (131)	11 (10)	437 (403)	1	34
Non-Networked	13 (3)	543 (120)	113 (103)	4,087 (3,664)	10	423
Tesla	22 (22)	793 (793)	90 (90)	3,760 (3,760)	0	0

Source: U.S. Department of Energy, Alternative Fuels Data Center, 2020, https://afdc.energy.gov/data_download

TABLE B: EV DC Fast Charging Network Companies, By Property Business Model Considerations

Network	Pricing	Notable Features	DC Fast PA Partners - Summary	PA Pricing Structures
Blink	Network and/or property manager sets prices.	Provides flexible revenue-sharing models.	5x Shopping Centers/Service Plazas; 4x Other, Non-Commercial	Level 2: $0.49 per kWh, DC Fast: $0.59 per kWh (5x Shopping Centers); Free (4x Other)
ChargePoint	Property manager sets prices.	Provides charging hardware, software, installation services, and ongoing technical and operational support.	7x Auto (5x Harley-Davidson); 1x Convenience/Gas	Free; $0.11/kWh; $0.18/kWh; $0.2/kWh; 0.29/kWh; $1/kWh; $0 per hour for the first 1 hour, and $2 per additional hour, $0.25 per kWh
Electrify America	Network sets prices.	Selects sites based on national network priorities identified in *Zero Emission Vehicle (ZEV) Investment Plan* funded and approved by the EPA.	4x Convenience/Gas (4x Sheetz); 4x Walmart; 2x Shopping Center/Service Plaza	Free Subscription: $1 session fee + power level pricing ($0.25/min, 75 kW; $0.69/min, 125 kW; $0.99/min, 350 kW). Paid Subscription: $4 monthly fee + power level pricing ($0.18/min, 75 kW; $0.50/min, 125 kW; $0.70/min, 350 kW).
EVgo	Network sets prices.	Selects sites based on revenue potential.	8x Food (7x Dunkin); 5x Shopping Centers/Service Plazas; 2x Convenience Gas; 2x Other, Non-Commercial; 1x Auto	Free subscription (Pay as you go): $0.30/min (DC Fast), $1.50/hr (Level 2). Paid subscription: $7.99 monthly fee + $0.27/min, w/ 29 min. free charging included (DC Fast), $1.50/hr (Level 2). No setup or session fees.
Greenlots	Property manager sets prices.	Provides charging software, installation services, and ongoing technical and operational support.	1x Other, Non-Commercial	Level 2: $1.00 per hour
Non-Networked	Property manager sets prices (typically free)	Unable to be monitored or operated remotely.	10x Auto (8x Nissan); 2x Convenience/Gas; 1x Other, Non-Commercial	Free (10x Auto); $1 per five minutes (2x Sheetz); N/A (Gettysburg Nat. Park)
Tesla	Network sets prices.	Serves only Tesla vehicles and thus not considered public by FHWA AFC program.	12x Convenience/Gas (11x Sheetz); 5x Shopping Centers/Service Plazas; 2x Food; 2x Hotel; 1x Other, Non-Commercial	$0.28 per kWh; $0.26 per minute above 60 kW and $0.13 per minute at or below 60 kW

Source: U.S. Department of Energy, Alternative Fuels Data Center, 2020, https://afdc.energy.gov/data_download

TABLE C: CNG Station Facility Types - Pennsylvania[46]

CNG Facility Type	Number	Station Names
Pennsylvania	**88**	-
Public	**53**	-
Standalone Station	33	8x GAIN Clean Fuel; 5x Trillium (incl. 4x Transit Authority/Service); 3x Clean Energy; 3x Clean N' Green; 2x "O" Ring CNG Fuels; 12x Other
Fleet Garage	6	5x Trillium (incl. 5 x Transit Authority/Service); River Valley Transit
Convenience Store	6	3x American Natural; Get-Go; Sunoco A-Plus Convenience
Gas Station	2	"O" Ring CNG/GAIN Clean Fuels; Sunoco
Municipal Government	2	Clean Energy - King of Prussia; Lancaster County Solid Waste Management
Travel Center	2	Clean Energy - Carlisle Flying J; 7-Eleven - New Stanton Service Center
Airport	1	Clean Energy - Philadelphia Int. Airport – Wally Park
Grocery Store	1	Giant Eagle – OK Grocery
Private	**35**	-
Fleet Garage	17	5x Trillium (incl. 5x Transit Authority/Service); 4x Transit Authority/Service (various); 6x Waste Management (various); 2x UGI Utilities
Standalone Station	7	2x Trillium - Proctor & Gamble; 2x United Parcel Service; US Steel Corp; Clean Energy - PECO corporate office; Giant Eagle – Warehouse
Office Building	4	3x Aqua America; Westmoreland Conservation District
School	3	3x High School (Harriton HS; Lower Merion HS; Penncrest HS)
College Campus	2	Bryn Mawr College; West Chester University
Municipal Government	1	Lancaster County Solid Waste Management
Utility	1	Peoples Natural Gas

Source: U.S. Department of Energy, Alternative Fuels Data Center, 2020, https://afdc.energy.gov/data_download

[46] For reference, the three CNG AFC stations along the I-81/I-78 corridor are: 1) a Clean Energy station located at a travel center (Flying J) near the PA Turnpike interchange in Carlisle, PA (I-81 Exit 52); 2) a GAIN Clean Fuel standalone station in Fredericksburg (I-78 Exit 6/8); and 3) a Trillium-operated station in the fleet garage of the Lehigh and Northampton Transportation Authority (LANTA) parking lot in Allentown (I-78 Exit 57).

TABLE D: EV Level 2-Only Stations: I-81/I-78 PA Corridor

Owner	Exit	Address	Details (Type, Outlets, Connector, Network)	Distance from Near Exit*
Fitzgerald Nissan	I-81 #16	1436 Lincoln Way E Chambersburg, PA 17201	Level 2, 1, J1772, Non-Networked	<1 mi.
Wilson College Science Center	I-81 #17	1015 Philadelphia Ave Chambersburg, PA 17201	Level 2, 1, J1772, Non-Networked	2 mi.
Computer Tutor	I-81 #17	2492 Philadelphia Ave Chambersburg, PA 17201	Level 2, 2, J1772, SemaCharge Network	3.5 mi.
Adams Energy Resources (AER)	I-81 #29	10 Duncan Rd Shippensburg, PA 17257	Level 2, 2, J1772, ChargePoint Network	4 mi.
Green Ridge Village (GRV) Retirement Homes	I-81 #37	210 Green Ridge Ln Newville, PA 17241	Level 2, 2, J1772, ChargePoint Network	4 mi.
Carlisle House Bed & Breakfast - Tesla Destination	I-81 #47	148 S Hanover St Carlisle, PA 17013	Level 2, 2, J1772, Tesla Destination	<1 mi.
Sun Motor Cars	I-81 #52 NB #57 SB	6691 Carlisle Pike Mechanicsburg, PA 17050	Level 2, 2, J1772, ChargePoint Network	4 mi.
Deloitte	I-81 #57	300 Sterling Pkwy Mechanicsburg, PA 17050	Level 2, 4, J1772, ChargePoint Network	3 mi.
City of Harrisburg (2nd & State)	I-81 #67	409-477 N 2nd St Harrisburg, PA 17101	Level 2, 1, J1772, ChargePoint Network	4 mi.
City of Harrisburg (3rd & North)	I-81 #67	700 N 3rd St Harrisburg, PA 17102	Level 2, 8, J1772, ChargePoint Network	4 mi.
Comcast	I-81 #69	2800 Valley Rd Harrisburg, PA 17110	Level 2, 4, J1772, ChargePoint Network	4 mi.
Sunoco (Greenlots – 182155)	I-81 #70	3801 Walnut St Harrisburg, PA 17109	Level 2, 2, J1772, Greenlots	2 mi.
Faulkner Nissan	I-81 #70	3925 Paxton St Harrisburg, PA 17111	Level 2, 1, J1772, Non-Networked	4.5 mi.
AACA Antique Automobile Museum - Tesla Destination	I-81 #77	161 Museum Dr Hummelstown, PA 17036	Level 2, 3, J1772, Tesla Destination	5 mi.
Hotel Hershey	I-81 #77 EB #80 WB	100 Hotel Rd Hershey, PA 17033	Level 2, 2, J1772, ChargePoint Network	7 mi.
Inn at Westwynd Farm, a Select Registry Property - Tesla Destination	I-81 #77 EB #80 WB	1620 Sand Beach Rd Hummelstown, PA 17036	Level 2, 2, J1772, Tesla Destination	4.5 mi.
Jaguar Land Rover (Bennett)	I-78 #51 EB #53 WB	5254 Tilghman St Allentown, PA 18104	Level 2, 1, J1772, ChargePoint Network	1.5 mi.
Daniels BMW	I-78 #51 EB #53 WB	4600 Crackersport Rd Allentown, PA 18104	Level 2, 2, J1772, ChargePoint Network	3 mi.
Whole Foods Allentown	I-78 #54	735 Krocks Ct Allentown, PA 18106	Level 2, 2, J1772, ChargePoint Network	2 mi.
Macungie Memorial Park	I-78 #57	50 Poplar St Macungie, PA 18062	Level 2, 1, J1772, Non-Networked	5 mi.

Owner	Exit	Address	Details (Type, Outlets, Connector, Network)	Distance from Near Exit*
Rothrock Motor Sales	I-78 #55 EB #57 WB	1648 Plaza Ln Allentown, PA 18104	Level 2, 3, J1772, Non-Networked	5 mi.
Allentown Parking Authority (APA)	I-78 #57	901 Walnut St Allentown, PA 18102	Level 2, 2, J1772, ChargePoint Network	3 mi.
Allentown Parking Authority (APA)	I-78 #57	820-836 Linden St Allentown, PA 18101	Level 2, 4, J1772, ChargePoint Network	3 mi.
Five City Center Allentown	I-78 #57	777 Walnut St Allentown, PA 18101	Level 2, 3, J1772, ChargePoint Network	3 mi.
Allentown Parking Authority (APA)	I-78 #57	624-632 Linden St Allentown, PA 18101	Level 2, 2, J1772, ChargePoint Network	3.5 mi.
Allentown Parking Authority (APA)	I-78 #57	622 Linden St Allentown, PA 18101	Level 2, 2, J1772, ChargePoint Network	3.5 mi.
Allentown Parking Authority (APA)	I-78 #57	13 S 6th St Allentown, PA 18101	Level 2, 2, J1772, ChargePoint Network	3 mi.
Allentown Parking Authority (APA)	I-78 #57	546 Hamilton St Allentown, PA 18101	Level 2, 2, J1772, ChargePoint Network	3 mi.
Allentown Parking Authority (APA)	I-78 #57	110 N 6th St Allentown, PA 18101	Level 2, 4, J1772, ChargePoint Network	3.5 mi.
Allentown Parking Authority (APA)	I-78 #57	33 N 6th St Allentown, PA 18101	Level 2, 4, J1772, ChargePoint Network	3.5 mi.
Allentown Parking Authority (APA)	I-78 #57	401 Hamilton St Allentown, PA 18101	Level 2, 4, J1772, ChargePoint Network	3.5 mi.
Homewood Suites, Hilton Allentown Bethlehem - Tesla Destination	I-78 #60	3350 Center Valley Pkwy Center Valley, PA 18034	Level 2, 4, J1772, Tesla Destination	2 mi.
The Inside Scoop - Tesla Destination	I-78 #60	301 N 3rd St Coopersburg, PA 18036	Level 2, 2, Tesla Destination	5 mi.
Lehigh University	I-78 #67	615 Brodhead Avenue Bethlehem, PA 18015	Level 2, 2, J1772, ChargePoint Network	4 mi.
The Sayre Mansion, a Select Registry Property - Tesla Destination	I-78 #67	250 Wyandotte St Bethlehem, PA 18015	Level 2, 2, J1772, Tesla Destination	4 mi.
Lehigh University	I-78 #67	4 Farrington Square Bethlehem, PA 18015	Level 2, 2, J1772, ChargePoint Network	4 mi.
Bethlehem Parking Authority	I-78 #67	324 S New Street Bethlehem, PA 18015	Level 2, 2, J1772, ChargePoint Network	4 mi.
Lehigh University	I-78 #67	420 E Packer Ave Bethlehem, PA 18015	Level 2, 2, J1772, ChargePoint Network	4 mi.
Lehigh University	I-78 #67	111 Research Dr Bethlehem, PA 18015	Level 2, 2, J1772, ChargePoint Network	4 mi.
Sands Casino Resort Bethlehem - Tesla Destination	I-78 #67	77 Sands Blvd Bethlehem, PA 18015	Level 2, 3, Tesla Destination	3 mi.
Bethlehem Parking Authority	I-78 #67	1 Rubel St Bethlehem, PA 18018	Level 2, 2, J1772, ChargePoint Network	4.5 mi.
Bethlehem Parking Authority	I-78 #67	85 W North St Bethlehem, PA 18018	Level 2, 2, J1772, ChargePoint Network	4.5 mi.

Owner	Exit	Address	Details (Type, Outlets, Connector, Network)	Distance from Near Exit*
Walnut Street Garage - Tesla Destination	I-78 #67	33 West Walnut St Bethlehem, PA 18018	Level 2, 1, Tesla Destination	4.5 mi.
Kirkland Village	I-78 #67	3200 Kirkland Village Cir Bethlehem, PA 18017	Level 2, 2, J1772, ChargePoint Network	6 mi.
Human vs Room Escape Room - Tesla Destination	I-78 #71	4210 Fritch Dr Bethlehem, PA 18020	Level 2, 2, Tesla Destination	7 mi.
KRE Bethlehem Apartments	I-78 #71	4883 Riley Rd Bethlehem, PA 18020	Level 2, 2, J1772, ChargePoint Network	2.5 mi.
St. Luke's Hospital - Anderson Campus	I-78 #71	1872 St. Luke's Blvd Easton, PA 18045	Level 2, 7, J1772, Blink Network	2 mi.
Koch 33 Toyota	I-78 #71	3816 Hecktown Rd Easton, PA 18045	Level 2, 4, J1772, ChargePoint Network	5.5 mi.
Hilton Management LLC - Palmer View	I-78 #71	3600 Corriere Road Easton, PA 18045	Level 2, 1, J1772, SemaCharge Network	7 mi.
BMW Facilities	I-78 #71	3819 Prologis Pkwy Easton, PA 18045	Level 2, 2, J1772, ChargePoint Network	7 mi.
The Lafayette Inn, a Select Registry Property - Tesla Destination	I-78 #75	525 W Monroe St Easton, PA 18042	Level 2, 2, J1772, Tesla Destination	3 mi.

*Distances for locations within 5-mile buffer of corridor are calculated as driving distances and therefore may exceed 5 miles as-the-crow-flies from the corridor. Distances are rounded to the nearest half-mile.

Source: U.S. Department of Energy, Alternative Fuels Data Center, 2020, https://afdc.energy.gov/data_download

TABLE E: Corridor Connections with NHS and Other Roadways

Corridor	Road Classification	Route Numbers (Exit)*
I-81	Interstates	I-76 (52); I-83 (70); I-78 (89)
	US Routes	US-11 (3, 52, 59, 65); US-30 (16), US-15 (65); US-22 (67, 72); US-322 (67, 70)
	PA State Routes	PA-163 (1), PA-16 (5), PA-914 (10), PA-316 (14); PA-997 (20); PA-696 (24); PA-174 (29); PA-233 (37); PA-465 (44); PA-34 (47); PA-74 (48); PA-641 (49); PA-114 (57); PA-581 (59); PA-944 (61); PA-230 (67); PA-39 (77); PA-743 (80); PA-934 (85)
	Other Key Roads	Front Street (Downtown Harrisburg) (66)
I-78	Interstates	I-81 (1); I-476/PA Turnpike (51/53)
	US Routes	US-22 (6/8, 51/53, 71); US-222 (54)
	PA State Routes	PA-343 (6/8); PA-645 (10); PA-501 (13); PA-419 (17); PA-183 (19); PA-61 (29); PA-143 (35); PA-737 (40); PA-863 (45); PA-100 (49); PA-309 (51/53); PA-33 (51/53, 71); PA-222 (54); PA-29 (55); PA-145 (59/60); PA-309 (60); PA-412 (67); PA-611 (75)
	Other Key Roads	Lehigh Street (Downtown Allentown) (57)

* The route numbers are listed in order, as a driver would approach them traveling northbound, from the MD border to the NJ border. This order is indicated by the exit numbers (in parentheses).

TABLE F: Existing Highway Signage for Corridor Connections, by Exit, I-81/I-78 PA Corridor

I-81		I-78	
Exit	**Connections**	**Exit**	**Connections**
1	PA-163	90/1	I-81/I-78, PA-72, US-22
3	US-11	6/8†	PA-343, US-22
5	PA-16	10	PA-645
10	PA-914	13	PA-501
14	PA-316	15	
16	US-30	16	
17	Walker Road	17	PA-419
20	PA-997	19	PA-183
24	PA-696	23	
29	PA-174	29	PA-61
37	PA-233	30	
44	PA-465	35	PA-143
45	College Street	40	PA-737
47	PA-34	45	PA-863
48/49	PA-74, PA-641	49	PA-100
52*†	I-76/PA Turnpike, US-11	51/53*	I-476/PA Turnpike, US-22, PA-309, PA-33
57	PA-114	54	US-222, PA-222
59	PA-581, US-11, I-83	55	PA-29
61	PA-944	57†	Lehigh Street
65	US-11, US-15	58/59	PA-145
66	Front St. (Downtown Harrisburg)	60	PA-309, PA-145
67	US-22, PA-230	67*	PA-412
69	Progress Avenue	71	PA-33, US-22
70	I-83, US-322	75	PA-611
72	US-22		
77	PA-39		
80	PA-743		
85	PA-934		
90/1	I-81/I-78, PA-72, US-22		

*Includes existing EV AFC station

†Includes existing CNG AFC station

Source: PA Highways, https://www.pahighways.com/interstates/

TABLE G: Traffic Volume, All Exits, I-81/I-78 Corridor; Existing EV AFC Station

Route	Exit	City	County	Interstate		Off-Ramp Exits	
				Avg. Daily Traffic	Avg. Daily Truck Traffic	Avg. Daily Traffic	Avg. Daily Truck Traffic
I-81	1	Greencastle	Franklin	61,222	14,616	n/a	n/a
I-81	3	Greencastle	Franklin	53,459	15,486	7,394	516
I-81	5	Greencastle	Franklin	46,832	15,307	8,277	579
I-81	10	Marion	Franklin	43,979	15,473	3,062	214
I-81	14	Chambersburg	Franklin	46,889	15,765	9,111	639
I-81	16	Chambersburg	Franklin	51,831	14,451	8,965	626
I-81	17	Chambersburg	Franklin	59,915	15,483	6,878	480
I-81	20	Chambersburg	Franklin	55,488	16,291	7,428	520
I-81	24	Shippensburg	Franklin	47,855	15,626	5,147	360
I-81	29	Shippensburg	Cumberland	44,951	15,342	6,220	435
I-81	37	Newville	Cumberland	46,119	15,946	3,165	223
I-81	44	Carlisle	Cumberland	57,743	17,797	10,559	738
I-81	45	Carlisle	Cumberland	73,746	19,168	4,835	338
I-81	47	Carlisle	Cumberland	80,944	18,932	6,608	463
I-81	48/49	Carlisle	Cumberland	74,369	18,046	10,058	543
I-81	52	Carlisle	Cumberland	72,239	17,836	21,192	1,482
I-81	57	Mechanicsburg	Cumberland	76,182	18,434	8,922	1,158
I-81	59	Mechanicsburg	Cumberland	76,507	18,167	24,465	1,849
I-81	61	Enola	Cumberland	75,763	17,035	7,976	558
I-81	65	Enola	Cumberland	67,451	15,991	11,496	358
I-81	66	Harrisburg	Dauphin	82,544	20,502	10,940	767
I-81	67	Harrisburg	Dauphin	92,347	20,153	30,289	2,120
I-81	69	Harrisburg	Dauphin	99,446	18,334	13,606	953
I-81	70	Harrisburg	Dauphin	95,277	20,310	64,375	8,768
I-81	72	Harrisburg	Dauphin	73,685	19,377	12,190	987
I-81	77	Harrisburg	Dauphin	68,707	19,206	11,130	777
I-81	80	Grantville	Dauphin	64,652	20,901	6,840	478
I-81	85	Annville	Lebanon	57,681	19,486	3,356	235
I-81; I-78	89/1*	Jonestown	Lebanon	47,435	19,246	3,683	271
I-78	6/8	Fredericksburg	Lebanon	38,604	16,837	3,394	238
I-78	10	Myerstown	Berks	43,134	12,441	4,311	301
I-78	13	Bethel	Berks	44,297	12,433	3,786	267
I-78	15	Bethel	Berks	43,688	15,239	n/a	n/a
I-78	16	Bethel	Berks	45,326	15,607	1,341	69
I-78	17	Bethel	Berks	43,279	14,376	1,763	125

Route	Exit	City	County	Interstate		Off-Ramp Exits	
				Avg. Daily Traffic	Avg. Daily Truck Traffic	Avg. Daily Traffic	Avg. Daily Truck Traffic
I-78	19	Strausstown	Berks	37,777	12,697	2,927	204
I-78	23	Shartlesville	Berks	35,578	12,467	4,213	295
I-78	29	Hamburg	Berks	34,874	12,410	5,738	902
I-78	30	Hamburg	Berks	42,544	14,537	1,269	77
I-78	35	Lenhartsville	Berks	42,825	14,518	1,076	180
I-78	40	Lenhartsville	Berks	43,021	12,661	2,795	220
I-78	45	Kutztown	Lehigh	44,711	13,164	4,735	330
I-78	49	Fogelsville	Lehigh	68,784	17,832	24,507	1,716
I-78	51/53	Allentown	Lehigh	92,256	18,682	42,066	5,703
I-78	54	Allentown	Lehigh	99,465	15,717	22,587	1,582
I-78	55	Allentown	Lehigh	98,680	17,920	15,445	1,081
I-78	57	Allentown	Lehigh	94,232	16,560	15,335	1,072
I-78	58/59	Allentown	Lehigh	99,022	15,191	6,568	525
I-78	60	Center Valley	Lehigh	80,806	13,477	20,423	1,430
I-78	67	Bethlehem	Northampton	71,282	14,733	14,158	3,540
I-78	71	Easton	Northampton	71,435	16,603	23,485	1,878
I-78	75	Easton	Northampton	67,438	17,212	5,407†	378†

*Includes I-81 NB Exit 90 traffic counts (I-81 NB mile marker 89 is a merge onto I-78)
†Includes EB traffic only; WB off-ramp traffic not available

Source: PennDOT Traffic Information Repository (TIRe), 2020, https://www.dot7.state.pa.us/tire

TABLE H: Employment by Industry Sector, I-81/I-78 PA Corridor (Within 5 Miles)

	Focus Corridor (within 5 miles)		PA		Focus Corridor
NAICS Sector	Count	%	Count	%	Location Quotient
Total for All Sectors	588,484		5,741,293		
Health Care and Social Assistance	96,357	16.4%	1,030,516	17.9%	0.92
Retail Trade	64,005	10.9%	629,432	11.0%	0.99
Transportation and Warehousing	49,877	8.5%	267,911	4.7%	1.81
Manufacturing	47,665	8.1%	569,546	9.9%	0.82
Accommodation and Food Services	47,650	8.1%	469,236	8.2%	0.99
Educational Services	43,078	7.3%	504,664	8.8%	0.83
Admin. & Support, Waste Mgmt., Remediation	40,054	6.8%	314,247	5.5%	1.24
Public Administration	36,864	6.3%	187,096	3.3%	1.91
Finance and Insurance	29,328	5.0%	262,358	4.6%	1.09
Professional, Scientific, and Technical Services	29,259	5.0%	360,599	6.3%	0.79
Wholesale Trade	22,902	3.9%	218,596	3.8%	1.03
Other Services (excluding Public Admin)	20,423	3.5%	205,115	3.6%	0.97
Construction	19,904	3.4%	253,761	4.4%	0.77
Management of Companies and Enterprises	16,216	2.8%	140,884	2.5%	1.12
Arts, Entertainment, and Recreation	8,268	1.4%	89,165	1.6%	0.88
Information	7,379	1.3%	89,633	1.6%	0.81
Real Estate and Rental and Leasing	5,050	0.9%	63,295	1.1%	0.82
Utilities	2,060	0.4%	35,836	0.6%	0.67
Agriculture, Forestry, Fishing and Hunting	1,743	0.3%	23,963	0.4%	0.75
Mining, Quarrying, and Oil and Gas Extraction	402	0.1%	25,440	0.4%	0.25

Source: U.S. Census Bureau, OnTheMap Application and LEHD Origin-Destination Employment Statistics, 2017

TABLE I: Employee Characteristics, All Jobs, I-81/I-78 PA Corridor (Within 5 Miles)

Employee Characteristics	Focus Corridor 2017	Focus Corridor 2010	PA 2017
Male	49.3%	49.1%	49.50%
Female	50.7%	50.9%	50.50%
Age 29 or younger	22.7%	21.8%	22.70%
Age 30 to 54	52.7%	57.1%	52.10%
Age 55 or older	24.6%	21.1%	25.20%
$1,250 per month or less	22.7%	24.5%	23.30%
$1,251 to $3,333 per month	32.0%	36.2%	31.00%
More than $3,333 per month	45.4%	39.3%	45.70%
White Alone	86.6%	90.6%	84.30%
Black or African American Alone	8.7%	6.3%	10.90%
American Indian or Alaska Native Alone	0.3%	0.2%	0.20%
Asian Alone	3.0%	2.1%	3.40%
Native Hawaiian or Other Pacific Islander Alone	0.1%	0.1%	0.10%
Two or More Race Groups	1.3%	0.7%	1.20%
Not Hispanic or Latino	91.2%	94.6%	94.60%
Hispanic or Latino	8.8%	5.4%	5.40%
Less than high school	7.9%	6.7%	7.60%
High school or equivalent, no college	23.4%	23.7%	23.30%
Some college or Associate degree	24.5%	25.4%	23.90%
Bachelor's degree or advanced degree	21.6%	22.5%	22.50%

Source: U.S. Census Bureau, OnTheMap Application and LEHD Origin-Destination Employment Statistics, 2017

TABLE J: Job Distance from Home, All Jobs, I-81/I-78 PA Corridor (Within 5 Miles)

Jobs by Distance - Work Census Block to Home Census Block	Count	%	Count	%
Total All Jobs	588,484		5,741,293	
Less than 10 miles	279,839	47.60%	2,960,175	51.60%
10 to 24 miles	140,110	23.80%	1,551,432	27.00%
25 to 50 miles	75,113	12.80%	569,477	9.90%
Greater than 50 miles	93,422	15.90%	660,209	11.50%

Source: U.S. Census Bureau, OnTheMap Application and LEHD Origin-Destination Employment Statistics, 2017

TABLE K: Commuting Patterns, All Jobs, I-81/I-78 PA Corridor (Within 5 Miles)

Inflow/Outflow Job Counts (All Jobs)	Count	%
Employed in the Selection Area	588,484	100.00%
Employed in the Selection Area but Living Outside	303,596	51.60%
Employed and Living in the Selection Area	284,888	48.40%
Living in the Selection Area	515,113	100.00%
Living in the Selection Area but Employed Outside	230,225	44.70%
Living and Employed in the Selection Area	284,888	55.30%

Source: U.S. Census Bureau, OnTheMap Application and LEHD Origin-Destination Employment Statistics, 2017

TABLE L: Employment by Metropolitan/Micropolitan Area, All Jobs, I-81/I-78 PA Corridor (Within 5 Miles)

Metropolitan/Micropolitan Areas	2017 Employment	2010 Employment	2010-2017 Growth
All Metropolitan/Micropolitan Areas (CBSA)	588,484	551,438	37,046
Allentown-Bethlehem-Easton, PA-NJ (Partial)	255,644	223,843	31,801
Harrisburg-Carlisle, PA (Partial)	247,906	245,592	2,314
Chambersburg-Waynesboro, PA (Partial)	43,016	38,656	4,360
Hagerstown-Martinsburg, MD-WV (Partial)	16,373	21,957	-5,584
Reading, PA (Partial)	15,199	12,346	2,853
Lebanon, PA (Partial)	9,156	8,103	1,053
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD (Partial)	649	553	96
Pottsville, PA (Partial)	415	288	127
New York-Newark-Jersey City, NY-NJ-PA (Partial)	126	100	26

Source: U.S. Census Bureau, OnTheMap Application and LEHD Origin-Destination Employment Statistics, 2017

TABLE M: Driving PA Forward-Funded Projects, by Location and Project Status

Drive PA Forward-Funded Projects	Completed	In Progress	Total
Pennsylvania	162	150	312
I-81/I-78 PA Corridor	23	12	35
Allentown	8	2	10
Bethlehem	3	6	9
Camp Hill	1	0	1
Carlisle	3	1	4
Chambersburg	1	0	1
Coopersburg	1	0	1
Easton	1	0	1
Harrisburg	1	1	2
Hellertown	0	1	1
Lemoyne	1	0	1
Mechanicsburg	1	0	1
Newville	1	0	1
Shippensburg	1	1	2

TABLE N: Driving PA Forward-Funded Projects, by Grant Recipient, I-81/I-78 PA Corridor

Recipient	Funded Projects
Allentown Parking Authority	7
Bethlehem Parking Authority	6
Dickinson College	3
Lehigh University	2
AAA Northampton County	1
Adams Energy Resources	1
Autobahn Speedway	1
Ballast Realty	1
City Center Allentown	1
Evoke Solar	1
Five City Center	1
Freysinger Hyundai	1
Inside Scoop	1
Northampton County	1
Presbyterian Senior Living	1
Smith Land & Improvement Corp.	1
SunnyDev Inc	1
The Computer Tutor Learning Center & Technical Services, LLC	1
Volvo Construction Equipment North America, LLC	1
Wacker Chemical	1
Walnut Enterprise LP	1
Total	**35**

TABLE O: 2020 Alternative Fuel Incentive Grant (AFIG) Awardees

Awardee	Description
Multicounty	
Ingevity Corporation	$256,745 to equip 28 vehicles in eight Pennsylvania-based fleets with its adsorbed natural gas technology and install refueling infrastructure at each fleet's location to study the environmental and economic impacts of using this renewable natural gas technology. Fleets are based in Allegheny, Erie, Lancaster, Philadelphia, and Washington counties.
Tri-County Transportation	$313,500 for the purchase of 33 propane school buses that serve schools in Indiana and Jefferson counties.
Waste Management of Pennsylvania	$200,000 to purchase eight CNG garbage trucks that serve Bucks, Lackawanna, and Montgomery counties.
Allegheny County	
Allegheny County	$30,000 to purchase four EVs.
City of Pittsburgh	$160,000 for the purchase of eight EVs and one electric bucket truck that will be used for tree maintenance in the city. The vehicles are part of a project that also includes charging stations supported by a DEP Pennsylvania Energy Development Authority COVID-19 Restart Grant.
TARS Trucking	$52,500 for the purchase of a Tesla electric tractor-trailer to haul metal freight to and from steel manufacturers, suppliers, and end-users in the Pittsburgh region.
Berks County	
Albright College	$96,708 to install two solar-powered Level 2 EV chargers and $27,305 to lease five EVs.
Wilson School District	$197,500 to install a propane fueling station for school buses.
Dauphin County	
Derry Township School District	$34,000 to purchase four propane school buses.
Delaware County	
Delaware County	$112,500 to purchase 15 EVs and $35,740 to install six Level 2 charging stations.
Erie County	
Northwestern Rural Electric Cooperative Association	$149,849 to install two direct current fast chargers for EVs for public use at a Country Fair service station in Edinboro.
Lancaster County	
Lancaster Solid Waste Management Authority	$240,000 to purchase six CNG waste transfer trucks.
Lehigh County	
Lehigh University	$24,412 to purchase three EVs and one electric all-terrain vehicle as part of transitioning the university police department to EVs.
Montgomery County	
Lower Merion School District	$289,590 to purchase 10 CNG school buses.
United Parcel Service	$300,000 to purchase 35 CNG delivery vehicles based at the Horsham facility.

Awardee	Description
Westmoreland County	
DMJ Transportation	$300,000 for the purchase of 34 propane school buses serving Greater Latrobe School District.
Shank Waste Service	$300,000 for the purchase of eight CNG garbage trucks.
United Parcel Service	$300,000 to purchase 35 CNG delivery vehicles based at the New Stanton facility.

Source: PA DEP, 2021, https://www.ahs.dep.pa.gov/NewsRoomPublic/articleviewer.aspx?id=21953&typeid=1