Tennessee CNG Station

Development Summary & Reference Guide

Written by the East Tennessee Clean Fuels Coalition for the Long Range Planning Division of the Tennessee Department of Transportation.

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ACRONYMS

AFC	= alternative fuel corridor
AFDC	= U.S. DOE's Alternative Fuels Data Center
AFVI	= Alternative Fuel Vehicle Institute
BTU	= British thermal units
CNG	= compressed natural gas
DAC	= disadvantaged community
DGE	= diesel gallon equivalent
DOE	= Department of Energy
EPA	= U.S. Environmental Protection Agency
ETCleanFuels	= East Tennessee Clean Fuels Coalition
FHWA	= U.S. Federal Highway Administration
FY	= fiscal year
GGE	= gasoline gallon equivalent
GHG	= greenhouse gas(es)
KUB	= Knoxville Utilities Board (local gas utility district)
LHV / HHV	= lower / higher heating value
LNG	= liquified natural gas
MCF	= thousand cubic feet (a unit of measurement for natural gas)
MLGW	= Memphis Light Gas and Water (local gas utility district)
mmbtu	= millions of BTUs
MPO	= Metropolitan Planning Organization
NGV	= natural gas vehicle
NGVA	= Natural Gas Vehicles for America *(renamed in 2024 to "The Transport Project")*
O&M	= operations and maintenance
psi	= pounds per square inch (the way pressure is measured in gas pipelines in the U.S.)
RFS	= Renewable Fuel Standard
RNG	= renewable natural gas (can be associated with or used as CNG or LNG)
RNG Coalition	= the Coalition for Renewable Natural Gas
RPO	= Rural Planning Organization
SCF	= standard cubic feet (of natural gas)
SCUD	= Sevier County Utility District (local gas utility district)
TDEC OEP	= Tennessee Department of Environment and Conservation Office of Energy Programs
TDOT	= Tennessee Department of Transportation
TGA	= Tennessee Gas Association

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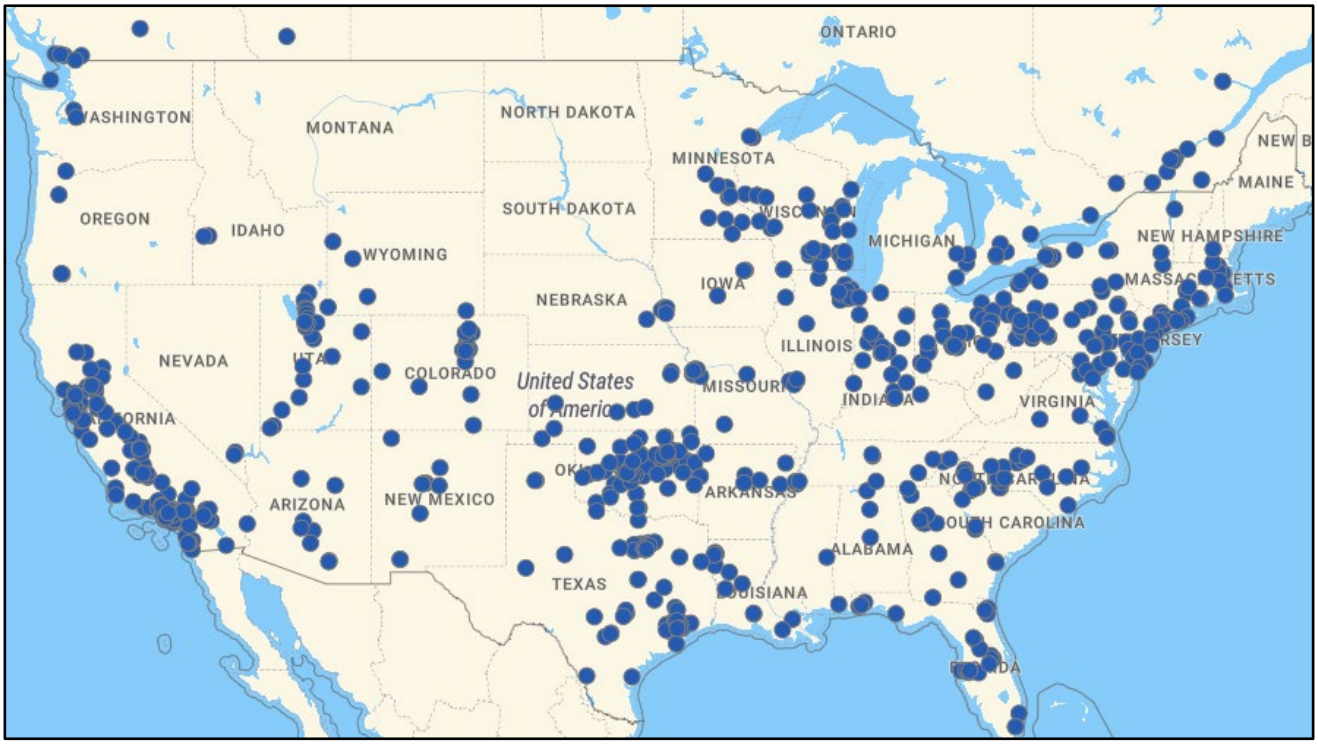
Background

Per the U.S. Alternative Fuels Data Center (AFDC), "As of 2022, more than 800 public compressed natural gas (CNG) fueling stations are available in the United States." Additionally, approximately 50 public liquified natural gas (LNG) fueling stations are available, mostly serving the class-8 trucking industry. Vehicles that run on natural gas are called "natural gas vehicles," or "NGVs." The Transport Project is the leading industry organization for CNG and states that "… there are more than 135,000 NGVs on U.S. roads today, spanning all weight classes and vehicle applications." Figure 1 shows a map of the 774 public CNG stations in the U.S. as of April 2024, and Figure 2 shows a map of the public CNG station in Tennessee (per the AFDC Station Locator). There are an additional 705 private CNG stations across the country as well – almost as many as there are public.

Figure 1. Recent Map of Public CNG Stations in the U.S.



Review of the map in Figure 1 shows more dense and more sparse areas of the country where CNG stations are located. For example, California, Oklahoma, and Washington DC to Boston all show heavier densities of CNG stations. Other places where CNG stations are prominent but not as dense include Texas, North Carolina, Indiana, Ohio, Pennsylvania, and Florida… all of which have more (or many more) than 10 public stations. Tennessee ends up in a third tier of CNG station density, as we have nine public stations in the entire state. There are multiple *private* CNG refueling locations in Tennessee that are not shown on the map, and at least one location in Lebanon, TN that just needs some addition work to become a public station, but the natural gas utility district that operates it has not finished their efforts to make it have an active, public CNG station.

Figure 2. Recent Map of Public CNG Stations in Tennessee

Review of Figure 2 shows the public CNG stations in Tennessee as blue dots – there are currently nine public CNG stations in the state. The yellow and black pointers highlight the public stations that sell CNG as renewable natural gas or "RNG" – that is five of the total nine public stations! In almost every case, renewably produced natural gas is produced elsewhere, and the station owner/operator is simply allocating the related greenhouse gas (GHG) reductions that come with using such to the gallons sold at those stations. Additionally, there is a public CNG station in West Memphis, Arkansas that is very close to the state line yet across the border. Private stations are not shown on the map as they do not help traveling fleets have locations to refuel, but they have been included in the table and photos later for educational purposes.

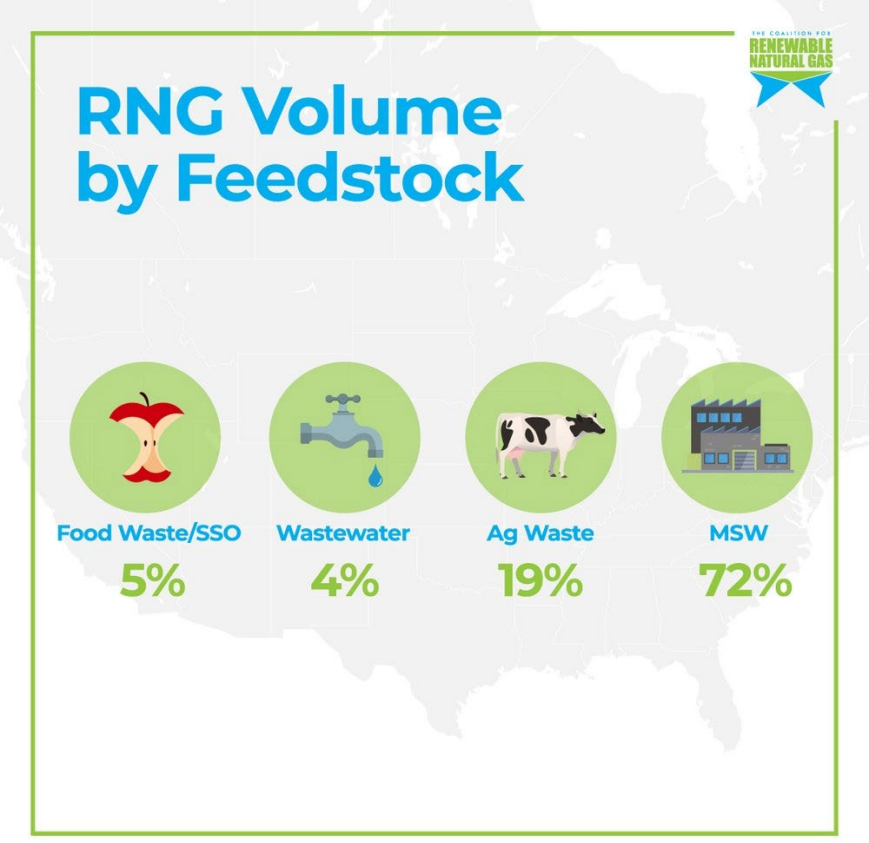
FACT: To understand the scale of the opportunity, although natural gas is a proven, reliable alternative fuel that has long been used to power natural gas vehicles in the U.S., only about two-tenths of 1 percent of all U.S.-produced natural gas is used for transportation fuel. (AFDC)

With regard to RNG, the program that provides structure to the generation, compliance, and environmental-benefits allocation for RNG in the U.S. is the Renewable Fuel Standard, or RFS, which was created under the Energy Policy Act of 2005 and further expanded by the Energy Independence and Security Act of 2007. Via the RFS, the EPA has been setting volume standards each year since 2009 for the production of renewable fuels via four different "pathways" (or ways to generate the fuel) that all have lifecycle GHG targets that range from 20-60 percent minimums. If fuel is produced via an approved pathway and meets all the specifications for that fuel, once it is blended into transportation fuel,

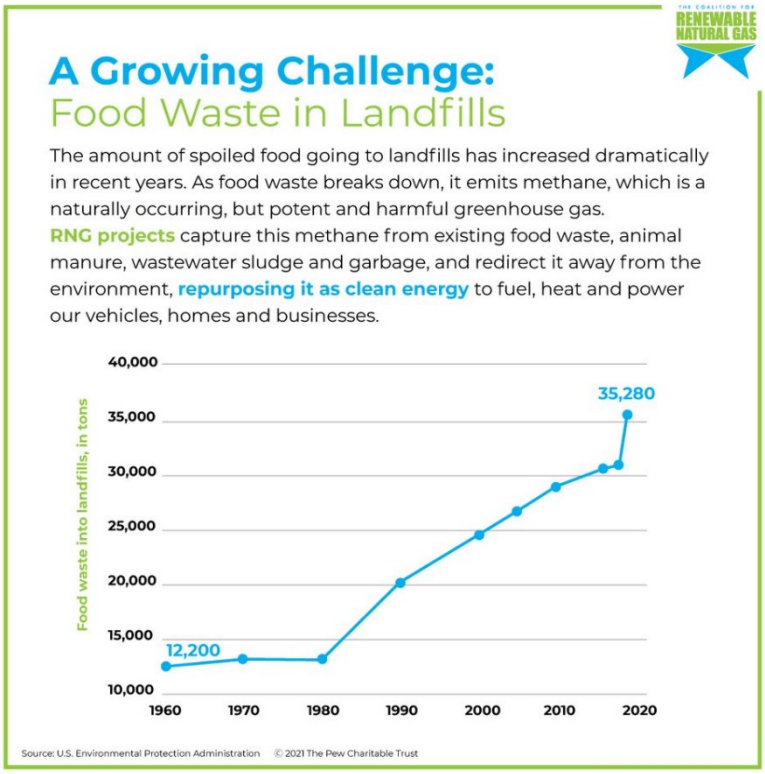
Renewable Identification Numbers or "RINS" are produced and become sellable or tradable credits. To learn more about the RFS, fuel pathways, compliance, and RINS, visit the EPA's RFS website.)
For this guide, the discussion of RNG will be limited to the resulting GHG reductions benefits. As is noted above, RNG is typically produced somewhere that is not where the station is (although there are examples where it is used where it is collected). It is an accounting methodology that allows the station owner/operator to provide actual pipeline, fossil CNG to a customer, but *allocate* the GHG reduction benefits (via the RFS) that come from producing RNG, that is fed into the local pipeline where it is produced. This accounting methodology is done by pairing the environmental attributes of the RNG with the CNG volumes that are dispensed at the CNG station. Based on an announcement by The Transport Project and the Coalition for Renewable Natural Gas (RNG Coalition) in April 2024, **79% of all on-road fuel used in natural gas vehicles in calendar year 2023 was RNG**, and that number has grown steadily over the past decade.

FACT: The opportunity to use gaseous, renewably produced transportation fuel has never been brighter. Using RNG as CNG simultaneously reduces GHG emissions while using what would otherwise have been a wasted resource to create the fuel.

The RNG Coalition is the trade association for RNG and has a wealth of information about RNG on their website. This includes their leadership, purpose, and operations; membership, which represents more than 98% of the RNG produced in North America; information on federal and state laws and regulations; and a plethora of educational resources including reports, white papers, infographics… and even an "RNG Kids" section where you can meet characters like Pete the Peel, Professor Onion, and Candace the Cow. At right and on the next page are two educational infographics from 2024.



In addition to the increasing utilization of RNG, another factor that is having a positive influence on the growth of the CNG transportation market is the introduction of the new Cummins 15-liter natural gas engine. This new engine platform reaches 500 horsepower (HP) and delivers the needed torque to providing the power and range for long-haul trucks that operate in the U.S., and is capable of meeting stringent EPA and CARB regulations. It is even expected to meet the forthcoming 2027 ultra-low EPA standards for NOx emissions.



CNG – A Long U.S. History

Because natural gas as CNG (and more recently as LNG) has been in use in the country for so long, and there are many publications already online that address how a station can be developed, we are not going to go into an in-depth conversation here about developing CNG stations in general. In this document we are detailing the specific needs *in Tennessee* to bring more stations to fruition for filling our FHWA gaps and generally bringing this helpful alternative fuel into greater use in our beautiful state.

The following is a long list of example documents that are available for reference now related to CNG stations development, station funding options, and storage, maintenance, and vehicle basics and needs.

CNG Station & Related Resources

1. America's Natural Gas Alliance and the American Gas Association – "**CNG Infrastructure Guide – for the Prospective CNG Developer**" (undated, link, PDF, 47 pp.)
2. Metro Magazine – "**Fleet Solutions: Tips for Designing a CNG Fueling Station**" (2014, link, website)
3. Government Fleet Magazine – "**Designing a CNG Fueling Station**" (2014, link)
4. P.C. McKenzie Company – "**CNG Station Design**" (undated, link, website)
5. TECO Energy – "**Installing a CNG Station**" (undated, link, website)

6. Ozinga Energy – " **Four Things to Consider when Building a CNG Fueling Station**" (2020, link), website
7. Tank Transport – "**Three Essential CNG Station Infrastructure Types for Optimal Fueling Solutions**" (2023, link, website)
8. North Carolina State University Clean Energy Technology Center – "**Planning and Installation Guide: North Carolina CNG Fueling Stations**" (undated, link, PDF, 8 pp.)
9. The Center for Climate and Energy Solutions – "**Applying the ESCO Model to Advance Deployment of Fleet Natural Gas Vehicles and Fueling Infrastructure**" (2014, link, PDF, 35 pp.)
10. Advanced Structural Technologies, Inc. – "**CNG Storage Options**" (undated, link, website)
11. NGVAmerica – "**Guidelines for Determining the Modifications Required for NGV Maintenance Facilities**" (2017, link, PDF, 33 pp.)
12. US DOE, Office of Energy Efficiency & Renewable Energy – "**CNG Maintenance Facility Modification Handbook**" (2017, link, PDF, 44 pp.)
13. National Renewable Energy Laboratory – "**Building a Business Case for Compressed Natural Gas in Fleet Applications**" (2015, link, PDF, 34 pp.)
14. AFDC – **CASE STUDIES** – 32 different publications on natural gas case studies (link)
15. US DOE, Office of Energy Efficiency & Renewable Energy – "**Natural Gas Vehicle Basics**" (2020, link, PDF, 4 pp.)
16. Argonne National Laboratory – "**Renewable Natural Gas (RNG) for Transportation, Frequently Asked Questions**" (2021, link, doc, 4 pp.)
17. US EPA – "**An Overview of Renewable Natural Gas from Biogas**" (2020, link, PDF, 55 pp.)

Major CNG Entities in the United States

Additionally, there are some well-known entities in the CNG and RNG industry in the U.S. (There are other major actors for CNG in the U.S., but the below are focused solely on natural gas for transportation use.)

1. **The Transport Project** – The nation's longest running and most prolific industry leader whose purpose is "To serve as the national voice advancing the growth and deployment of practical, clean, gaseous fuels for transportation." *Note that prior to 2024, The Transport Project was called "NGVAmerica" and existed under that name for over two decades.*
2. **The Coalition for Renewable Natural Gas**
3. **Clean Energy Fuels** – the United States largest CNG and RNG station developer.
4. **Alternative Fuel Vehicle Institute** – AFVI, which used to be called NGVI or the Natural Gas Vehicle Institute, is the longest running technical training entity in the U.S., who "is the only ASE-accredited training provider in the entire alternative fuels industry" and has trained over 25,000 technicians and professionals in the industry for more than 30 years. Of that number, the vast majority of that training has been focused on natural gas vehicles, stations, storage, and related equipment.

Our Stations in Data and Photos, and CNG Gaps in Tennessee

For those that do not know what a CNG station looks like, and even for those who do but have not seen one or more of the stations in Tennessee, we have compiled this table of station data, and a set of photos that follow. In Table 1, the stations are in order moving west to east across the state. Additionally, this information is provided before the CNG corridor gaps discussion so that the reader can be more knowledgeable on the stations as they are referred to in the gaps section. Furthermore, an Appendix is provided that shows satellite views of the stations (in the same order presented below).

Table 1. Data on CNG Stations in Tennessee

City	Owner/Operator – Name	# of Dispensers	Interstate Proximity *
	PUBLIC Stations		
Memphis	Memphis Light Gas & Water – South Center *(MLGW, link)*	2	I-240 / I-55 / I-69 (I-40 *)
Memphis	MLGW – North Center *(link)*	1	I-40 / I-69 (I-55 / I-240 *)
Nashville	Piedmont NG – Spence Lane *(link)*	3	I-40 / I-24 / I-65
Nashville	Clean N' Green *(link)*	1	I-24
Fayetteville	Beyond6 – Fayetteville *(link)*	3	US-64
Athens	Athens Utilities Board *(AUB, link)*	1	I-75
Knoxville	Knoxville Utilities Board *(KUB, link)*	3	I-40 / I-75
Sevierville	Sevier County Utility District *(SCUD, link)*	1	I-40 *
Newport	Beyond6 – Newport *(link)*	1	I-40
	PRIVATE Stations		
Memphis	WM of TN	*time-fill posts*	*n/a*
Jackson	WM of TN	*time-fill posts*	*n/a*
Madison	WM of TN	*time-fill posts*	*n/a*
Antioch	WM of TN	*time-fill posts*	*n/a*
Nashville	Piedmont Natural Gas	2	*n/a*
Nashville	ABM (for BNA)	3	*n/a*
Lebanon	City of Lebanon Gas Department	1	*n/a*
Tullahoma	Elk River Public Utility District	1	*n/a*
Crossville	Middle TN Natural Gas	*time-fill posts*	*n/a*
Wartburg	Citizens Gas Utility District	1	*n/a*
Knoxville	KUB	1	*n/a*
Sevierville	Sevier County Utility District	*time-fill posts*	*n/a*

** An asterisk beside the interstate means that it is MORE than five miles from the interstate. While a public CNG station in Tennessee, it does not assist in helping fill FHWA corridor gaps.*

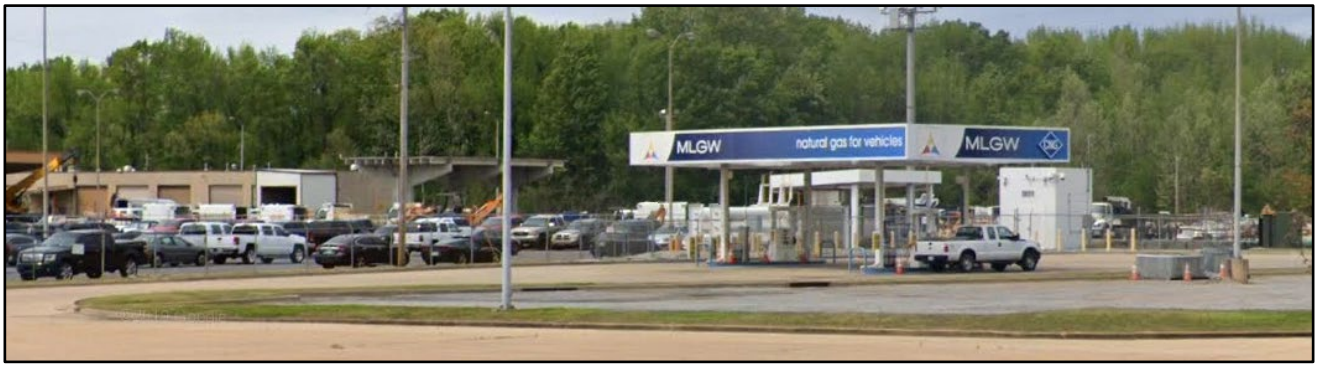
Tennessee CNG Station Photos

All of the photos were taken by the author or were provided by the station operator.

MLGW – SOUTH CENTER

This is one of two public CNG stations in the Memphis area; both are operated by MLGW. Both offer RNG (that is, reduced GHG CNG) to customers that refuel at the station. The station is very large with plenty of room for class 8 tractor-trailers to pull in, refuel, and exit.

Figures 3 and 4. MLGW South Center CNG Station in Memphis



MLGW – NORTH CENTER

This is the second of the two public CNG stations in Memphis, which also offers RNG to refuelers. This site is capable of refueling large vehicles (e.g. refuse trucks) but it would be difficult for a class 8 tractor-trailer to get into the refueling area.

Figure 5. MLGW North Center CNG Station in Memphis

PIEDMONT – SPENCE LANE

Piedmont's public CNG station in Nashville is the largest CNG station in the state and has *two different refueling areas in one footprint.* Piedmont designed the site to have separate ingress and egress points, better enabling class 8 trucks to use the station. There is an ingress point on the north side of the site, that is also up a slight hill – this is the upper level of the site. From there, an NGV can drive to the back of the site and then turn left and come back around pointing toward Spence Lane, and refuel at the lower level. The lower-level station was developed first and has two refueling islands with one two-sided dispenser on each island. A few years later, Piedmont decided to build another refueling area, with its own compression, drying, and storage systems, on the upper level, and the site now provides an additional dispenser to refuel vehicles there. Figures 6 and 7 show the lower-level station, before the upper-level station was built. Additionally, this site provides RNG to customers who fuel there.

Figures 6 and 7. Piedmont CNG Station in Nashville

CLEAN N' GREEN – ANTIOCH

In a few locations around the country, Waste Management works with partners to develop public CNG refueling just outside of properties where they operate private CNG refueling for their fleet. This station is one of those few examples and provides easy access from I-24 just south of Nashville to fleets, and class 8 trucks can get in and out of this site.

Figure 8. Clean N' Green CNG Station in Antioch

BEYOND6 – FAYETTEVILLE

This CNG station was built to service the Frito-Lay manufacturing facility that is just down the street and across US-64. The "anchor tenant" is Frito-Lay but they decided to build a public CNG station for its fleet refueling, which has the secondary benefit of providing other fleets with a CNG refueling opportunity.

Figure 9. Beyond6 CNG Station in Fayetteville

ATHENS UTILITIES BOARD - ATHENS

This public CNG station was commissioned by AUB and just off exit 49 on I-75. It is a great midpoint between Chattanooga and Knoxville, which is a distance of roughly 100 miles between the two larger cities. It was built for two purposes: refuel AUB's fleet of light-duty CNG trucks and provide another refueling point for NGVs travelling I-75.

Figures 10 and 11. AUB CNG Station in Athens

KNOXVILLE UTILITIES BOARD - KNOXVILLE

KUB designed and commissioned the construction of their public CNG station – and Knoxville's first – in the mid-2010's. As of the end of 2023, KUB had 90 NGVs that are mostly light-duty NGVs. Since the station opening, it has grown to service some larger fleet customers and a variety of smaller CNG fleets that operate in the area or travel through Knoxville needing CNG.

Figures 12 and 13. KUB CNG Station in Knoxville

SEVIER COUNTY UTILITY DISTRICT - SEVIERVILLE

Sevier County Utility District (SCUD) built this public CNG station to help serve their growing fleet needs, as well as the needs of the fleets they brought into using CNG during the 2010's. Dollywood and Sevier County School System are examples of local CNG fleets that now use the station on a regular basis. Class 8 fleets can access the station. While the station is 11 miles from the nearest interstate (I-40), Sevierville sits at the top of the tourist multi-metropolis that includes Pigeon Forge and Gatlinburg which includes many delivery fleets to the many businesses there.

Figures 14 and 15. SCUD CNG Station in Sevierville

<u>BEYOND6 – NEWPORT</u>

This public CNG station was built by Beyond6 to service a fleet out of Indiana that delivers milk products across a swath of the U.S., and that delivers down I-75 and across into North Carolina, passing Newport along the way. ANG or American Natural Gas is a subsidiary of Beyond6. This station sits on the backside of the Time Out Travel Center just off exit 432 on I-40, and can easily be accessed by class 8 tractor trailers. It provides a critical link to Asheville, NC – which is just over 70 miles from the station – through the Appalachian Mountains and provides RNG to fleets that set up an account with Beyond6 and request it.

Figure 16. Beyond6 CNG Station in Newport

As can be seen from the above photos, Tennessee has a fairly wide variety of station designs and layouts (although much larger stations with more islands and dispensers exist elsewhere in the U.S.). We have not included many other specifics of station design: the compressor sizes, the storage types and sizes, and whether oiled versus non-oiled compressors are in use, as examples. As is discussed later in this Guide, there are utility partners that want to help new fleets, utilities, or other station developers bring more CNG stations to Tennessee. Their expertise could be very helpful in navigating some of the complexities of putting together all the pieces that are needed to build new CNG stations.

What are CNG Station "Gaps," and Where are They?

In 2016, the U.S. Federal Highway Administration (FHWA) began the "Alternative Fuels Corridor (AFC) Program" which is a process to allow states to formally submit corridors in their states to the FHWA for approval as "designated," either as "Corridor-Ready" or "Corridor-Pending," routes or route segments. Including that first round, a total of seven rounds have been held where state DOTs (and their partners and collaborators in each state) conferred and submitted new corridors to FHWA (if they wished to add new corridors in that round) to be reviewed, and hopefully designated. The FHWA created definitions for what the two status titles mean, and those full definitions can be found here (p. 4). In short, a "Corridor-Pending" designation for CNG means there is a station that a) meets the public, fast-fill, and 3,600-psi requirements; b) meets the distance requirement that the station is less than five miles from the associated corridor (as the driver drives, not crow flies); however, that station is not c) less than 150 miles from the next designated station – in either direction – along that corridor. When two CNG stations meet all those requirements and are no more than 150 miles apart, those two stations become part of a "Corridor-Ready" segment or stretch of thoroughfare (most of the time these corridors are interstates, but U.S. Highways and other routes have also been designated by the FHWA). Figure 17 below shows our designated corridors in Tennessee for CNG: a solid line denotes "ready" status, while dotted lines indicate a "pending" status. Thus, Tennessee needs to fill in the dotted lines with new, public, compliant CNG stations that are no further than 150 miles to either of the public CNG stations that surround the gap.

For example, consider I-65. There is a station that meets the requirements in Huntsville, AL, and it is less than 150 miles (actual distance roughly 115 miles) heading north towards Nashville to the next station that meets the requirements (Piedmont Natural Gas' Spence Lane station). Therefore, that stretch is denoted as "Corridor-Ready." Continuing north on I-65 there is not another CNG station that meets the requirements within the next 150 miles so that section is denoted as "Corridor-Pending." I-75 end to end, I-24 end to end, I-65 from Nashville south, and I-40 from the I-75/I-40 junction to the state line are all the current (as of early 2024), "Corridor-Ready" route segments.

Figure 17. FHWA-approved CNG Corridors in Tennessee, and Public Stations

From viewing the map, the following stretches of interstates are **gaps** we have in Tennessee along our designated corridors.

- ✓ **I-40:** a) Memphis to Nashville, b) Nashville to Knoxville (a stretch from Dickson to Nashville shows as "Ready," however the CNG station in Dickson is not open anymore)
- ✓ **US-55:** entire stretch from Memphis northbound to Kentucky border
- ✓ **US-64:** entire stretch from Memphis to the North Carolina border
- ✓ **I-65:** northbound from Nashville to Kentucky border
- ✓ **I-81:** from southern terminus at I-40 to Virginia border
- ✓ **I-26:** from northern terminus at Kingsport southbound to North Carolina border

For these corridors, we know the following.

- ✓ Along I-40, there is a station in Lebanon, TN that has been developed by the local gas utility (the City of Lebanon Gas Department), however they had some difficulties a few years ago and have not been able to finish the station to make it public (although it is currently in use by the department to refuel its own NGVs). Additionally, some ingress and egress work may need to be done at this site to make it more easily accessible by class 8 trucks with trailers, however the site is not ideal based on several of the turns that are needed to get to the station. Thus, *while this station could be a corridor gap filler – it is almost exactly 150 miles from the KUB public CNG station in*

Knoxville – it would not enable class 8 truck refueling along I-40, without certain needed upgrades. (It is only about 25 miles to the west from Lebanon to the Piedmont Natural Gas station at Spence Lane.)

- ✓ Also, along I-40, Jackson is a good midpoint between Memphis and Nashville. It is about 78 miles from the MLGW North Center Station to the center of Jackson, and 135 miles from that same point to the Piedmont Natural Gas station on the east side of downtown Nashville.

Critical Aspects of Developing New CNG Stations in Tennessee

So, if Tennessee entities are to find new partners and partnerships to help fill in our current CNG gaps in the state, what are our critical needs? Who are the necessary players, what pieces of the puzzle must be present, and how can we build effective teams to realize these public CNG stations? The following are important factors that impact the ability to build new CNG stations here, and are major topics that need to be understood and addressed.

1. Major Partners – The local gas utility and anchor tenants
2. The Price (Must Be) Right
3. Pipeline pressures
4. Location, property
5. Funding opportunities
6. Known partners

Major Partners – The Local Gas Utility and Anchor Tenants

Just like the process for almost any alternative fuel, for CNG the local gas utility district needs to be involved from the very beginning. The only way a station can be developed *without* the local utility is if the gas will be *trucked onto the site* – and this is uncommon, although what are called "virtual pipelines" do exist and have been providing fuel to new CNG stations for nearly a decade (see this report from the NGVA on virtual pipelines). However, any team should work with the local utility *first* to evaluate project viability before considering a virtual option as they are likely the more expensive option. It will also help to learn of the pipeline pressures on the utility's gas distribution network, to get a basic understanding of the better or worse places to develop a new CNG station in their district (more explanation is provided below on this topic).

In Tennessee, if you do not know who the gas provider/utility is for an area, the fastest way to do that is to get in-touch with the **Tennessee Gas Association** (TGA). Executive Director Kelley Zamboni and the staff and membership of the TGA are wonderful people to work with, and ETCleanFuels has worked with many of the members over the past 15 years to elevate CNG in Tennessee, and develop new stations.

Next, CNG station development cannot start without an "anchor tenant" – one or more fleets that are going to refuel at the station on a regular basis once it is built and open. Station builders will not invest numbers in the range of $1-3 million dollars (or more with recent economic pressures) unless they know the station is going to be utilized, which is how they get their return on investment for building the station. Numbers along the lines of 20,000+ gasoline gallon equivalents (GGEs) per month of natural gas fuel purchasing (flow) are not uncommon, but what that needed fuel quantity will be is dependent on a number of factors, including the size of the stations and the business model of the station owner or developer.

Here are a couple of diverse anchor tenant examples in Tennessee:

1. **Knoxville Utilities Board (KUB) in Knoxville** – The KUB public CNG station in Knoxville, TN, which opened in 2017, was designed by KUB and developed by a well-known station-building contractor and resides on their property just to the northwest of downtown Knoxville off Middlebrook Pike. In this case – *and in numerous other cases across the country* – the local gas utility used **its own fleet as the anchor tenant** for the site. This is a common development pathway in cities where there are no other public CNG stations in the area and the utility is willing to make an investment to help develop CNG by developing or expanding their CNG fleet. Examples of CNG stations that used this model to develop public CNG infrastructure are plentiful across the country, but in almost all cases the utility is looking for other private or public fleets to begin using the station.
2. **Beyond6 in Newport** – The CNG station in Newport, TN was opened by Beyond6 in 2015. The reason the station was needed was that a fleet based in Indiana that had developed CNG resources and stations – including, with partners, RNG production – needed fueling when looking at their delivery routes branching out from their operations in that state. Newport was identified as a needed location. So, in this case, the anchor fleet was from two states away.
3. **Beyond6 in Fayetteville** – This CNG station was developed in partnership with Pepsi Co./Frito-Lay as there is a chips and snacks production facility nearby. Frito-Lay served as the anchor tenant and the station now provides public CNG refueling along the long US 64 corridor that connects Chattanooga to Memphis, TN.

To develop new CNG stations in Tennessee, it will likely be necessary to engage fleets both near and far.

The Price (Must Be) Right

There are multiple cost considerations when it comes to the final price to fleets to refuel at a CNG station. Some of the main ones include:

- ✓ the price that the utility will charge the station builder/owner for the gas,
- ✓ the station building costs including the amount of compression and storage that will be installed, and
- ✓ the price of diesel and gasoline locally.

Maybe not all, but many gas utilities have already figured out a plan for what they would charge anyone that wanted to build a CNG station in their territory. Many times, it exists as a separate rate schedule within the utility's set of schedules. Utilities most often charge for gas by the therm or "MCF" (thousand cubic feet) of gas that is sold, and so pricing is provided in $/therm or $/MCF. * These rates must be factored into the final cost of the gas that will be sold to the customer and can have a very substantial impact on that final cost. In Tennessee, the price of gasoline and diesel can often be some of the lowest rates found across the U.S.; see Figure 18, where Tennessee's average price for that one day was one of the nine lowest prices in the U.S. While anecdotal, the author has been watching gasoline and diesel

prices in the state for going on 20 years and Tennessee's pricing is routinely in the lowest 25 percent in the country. What this means is that those lower petroleum prices put downward pressure on what the CNG price needs to be at the station to make it a viable price – by comparison – for the fleets that will use that fuel.

Figure 18. Average Price of One Gallon of Gasoline on September 21, 2023

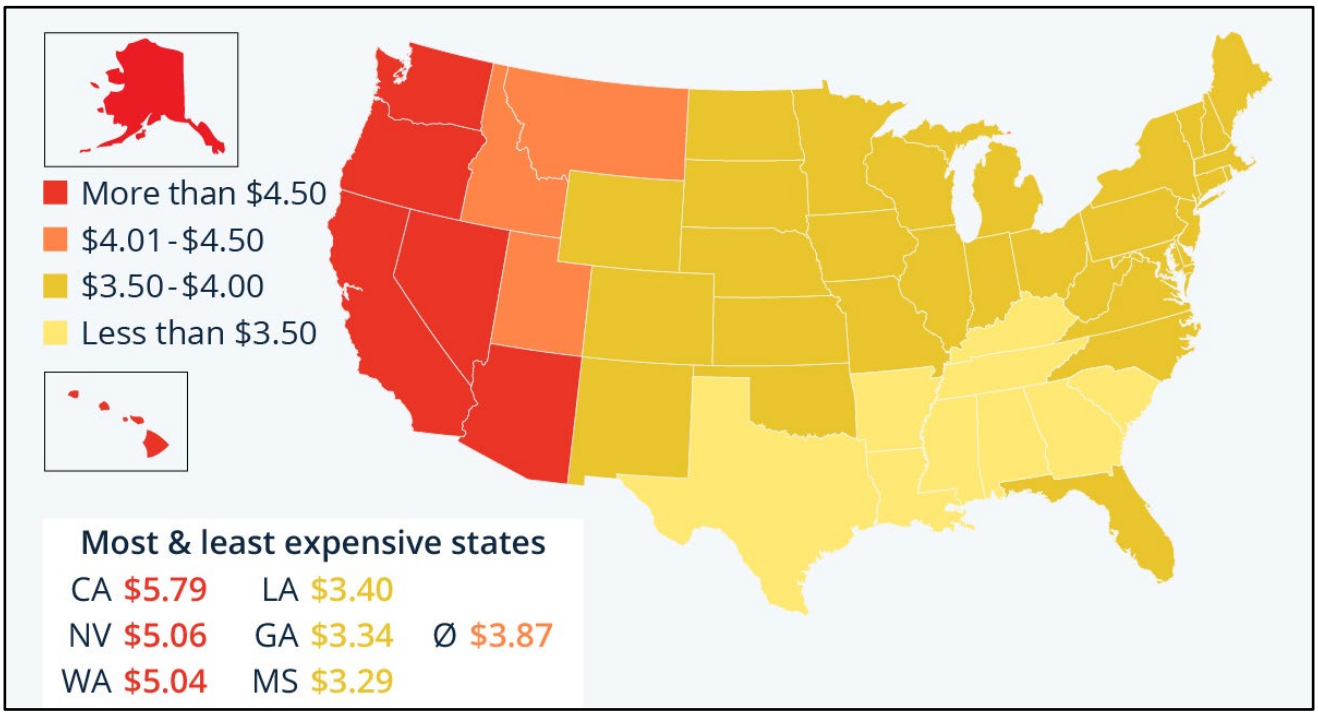


Photo credit: Statista (https://www.statista.com/chart/9432/lowest-and-highest-gasoline-prices-by-us-state/), with data from AAA.

** Other units are also used, and this can be one of the more confusing elements of working on CNG, for the CNG uninitiated. Conversion factors are fairly common and can be found – here, and here – but when converting from volumetric to energy content units, the conversion factors can change slightly because the gas that is in the pipeline around the U.S. can change slightly. Don't be surprised to see BTUs (British thermal units), mmbtus (millions of BTUs), SCF (standard cubic feet), GGEs (gasoline gallon equivalents), DGEs (diesel gallon equivalents), and LHV (lower heating value). Your local utility will be able to help convert units based on the gas in their system.*

Pipeline Pressures

The pressure of the local gas in the pipelines where gas is carried can vary substantially, from numbers on the order of 10 psi (pounds per square inch) to well over 200 psi. A well-known factor in the industry is that it takes a lot more compression power to raise a fuel to 3,600 psi from 10-40 psi, than it does from 150 psi. This means that a larger, more costly compressor must be purchased and used on a regular basis to sell the fuel, which adds to the total costs to operate the station. What's more, when electricity is used to run the compressor, if a larger compressor is used, then the electrical demand spike that is created when the compressor is turned on sets the demand peak higher. This might fall within the

demand range of the schedule, but it also might not, and can increase the monthly cost of running the station. Pipeline pressures can increase or decrease capital and operating costs for a station.

Location, Property

The variables that are paramount in station site selection include a) the distance from the anchor fleet and/or other fleets that might want to use the station, b) the distance from the interstate for ease of access by CNG fleets that are traveling interstate routes, c) ease of access onsite by all sizes of vehicles including class 8 tractor trailers, d) the pipeline pressure at the site, e) the proximity or location of the pipeline near or on the property, and f) the price of the property. All of these factors will play a role in the ultimate finances of the station, including affecting the use of the station, which impacts sales through the station.

Funding Opportunities

Please see **this document** for a discussion on funding options and opportunities to bring new public CNG stations to fruition in our state.

Known Partners

This category is about some specific people who are interested in helping others build CNG stations in Tennessee, to further the existence of public stations statewide, so that more refueling opportunities are along routes for fleets to use overall (making it easier to get more fleets to start using CNG).

One such person to mention is **Chip Gifford**, the manager of CNG business development for Piedmont Natural Gas. Piedmont is the natural gas provider for the greater Nashville area (nine counties served), and Gifford as of this writing serves on the ETCleanFuels Board of Directors. The author has known Gifford for nearly 10 years, and he has been a wonderful resource when CNG station work was ongoing in Tennessee and ETCleanFuels needed information or directional advice. Gifford has directly relayed that *he needs more public CNG stations in Tennessee to assist in more fully developing the use of fuel in their territory… and across the state.* Why would Gifford care about having a CNG station in say Jackson or Crossville, TN? Because some of the fleets he talks to that want to refuel or are refueling in the greater Nashville area would be better served if they had more stations going in every direction away from Nashville. **Likely the single most substantial barrier to having more fleets adopt and use CNG is the fact that there are not enough stations along the routes that their drivers need to take.** And these routes are not always along the major corridors that you might expect they would take.

Another person is **Ian Skelton**, the director of natural gas vehicles for Southern Company Gas, that is the parent company of Chattanooga Gas. The author has known Skelton for 15 years, and Skelton has been immensely helpful in holding events, talking with potential partners, and driving interest in CNG in the

Chattanooga area. Skelton is of the same ilk in that – as he can – he would help provide guidance or assistance if others might need advice along their path, if the end game could help elevate CNG in Tennessee.

Suggested Actions to Develop New CNG Stations in Tennessee

There are a number of hurdles to developing CNG stations in Tennessee's AFC gaps, or in other locations. New or renewed efforts to add more CNG stations in Tennessee, and in those gaps, could lead to new partnerships and opportunities, but it could also lead to dead ends. However, because of the value proposition of succeeding and making CNG – and quite possibly RNG – more widely available in Tennessee, it is worth the time, energy, and expense. The new efforts will need to encompass a variety of action items.

1. TDOT and the East and Middle-West TN Clean Fuels Coalitions could **host one-on-one virtual meetings with the right staff at the gas utilities in the gaps in Tennessee** (or in-person meetings, which could include visiting at any properties that the utility had or has in mind for potential stations). Ask them to provide an overview of past and current work on bringing fleets towards using CNG in their area, and ask about any prior station-building work. The team should also inquire about any rate schedules or just rates that the utility has for the sale of CNG. The discussions can provide a good, localized background on potential fleet interest and site opportunities.

2. Develop a new **CNG Station Development Team** for Tennessee. That team could pull together interested entities to discuss the locations, needed partners, and other variables that accompany such planning. Suggested partners to invite to such a team should or could include the representatives from the following organizations:

   - ✓ TDOT Long Range Planning
   - ✓ East Tennessee Clean Fuels Coalition
   - ✓ Middle-West Tennessee Clean Fuels Coalition
   - ✓ The "helpers" mentioned above
   - ✓ Interested gas utilities that are members of the TGA
   - ✓ The Tennessee utilities that already operate public CNG stations in TN
   - ✓ Industry companies that have shown an interest in building stations in Tennessee (e.g., Clean Energy Fuels, Beyond6, Trillium)
   - ✓ Industry partners that have built and use private stations in Tennessee, like Waste Management

   The CNG Station Development Team can identify manufacturers in Tennessee that have sustainability initiatives. Once identified, the team can educate how operating or having their carriers operate CNG/RNG trucks can help reduce their Scope 1 and Scope 2 emissions. ("Scope 1

emissions are direct GHG emissions that occur from sources that are controlled or owned by an organization [e.g., emissions associated with fuel combustion in boilers, furnaces, vehicles]. Scope 2 emissions are indirect GHG emissions associated with the purchase of electricity, steam, heat, or cooling." – EPA's Scope 1 and Scope 2 Inventory Guidance website)

3. The local utilities might be the best entities to do this, but **perform a property analysis in the gap cities, looking for the better CNG station locations** that would fit a) the FHWA corridor gap-filling needs, and b) serve the community as well for general CNG refueling. Obtain and record all the needed site data: size/acreage, ingress/egress options for heavy-duty trucks, natural gas pipeline pressures on or near the property, proximity to MD/HD fleets, etc.

Acknowledgements

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Lia Prince – Programs Manager, Long Range Planning Division

Appendix A – TN CNG Station Satellite Views

Figure A-1. MLGW, South Center – Memphis

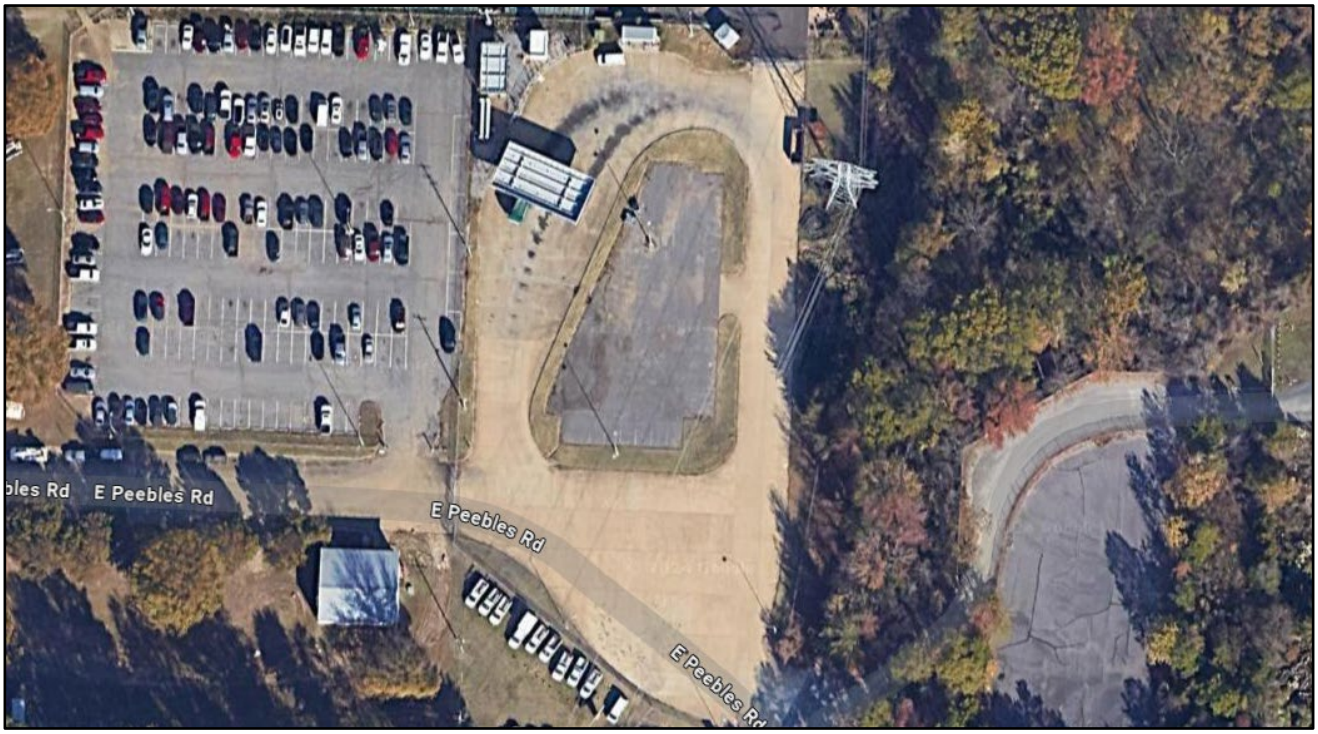

Figure A-2. MLGW, North Center – Memphis

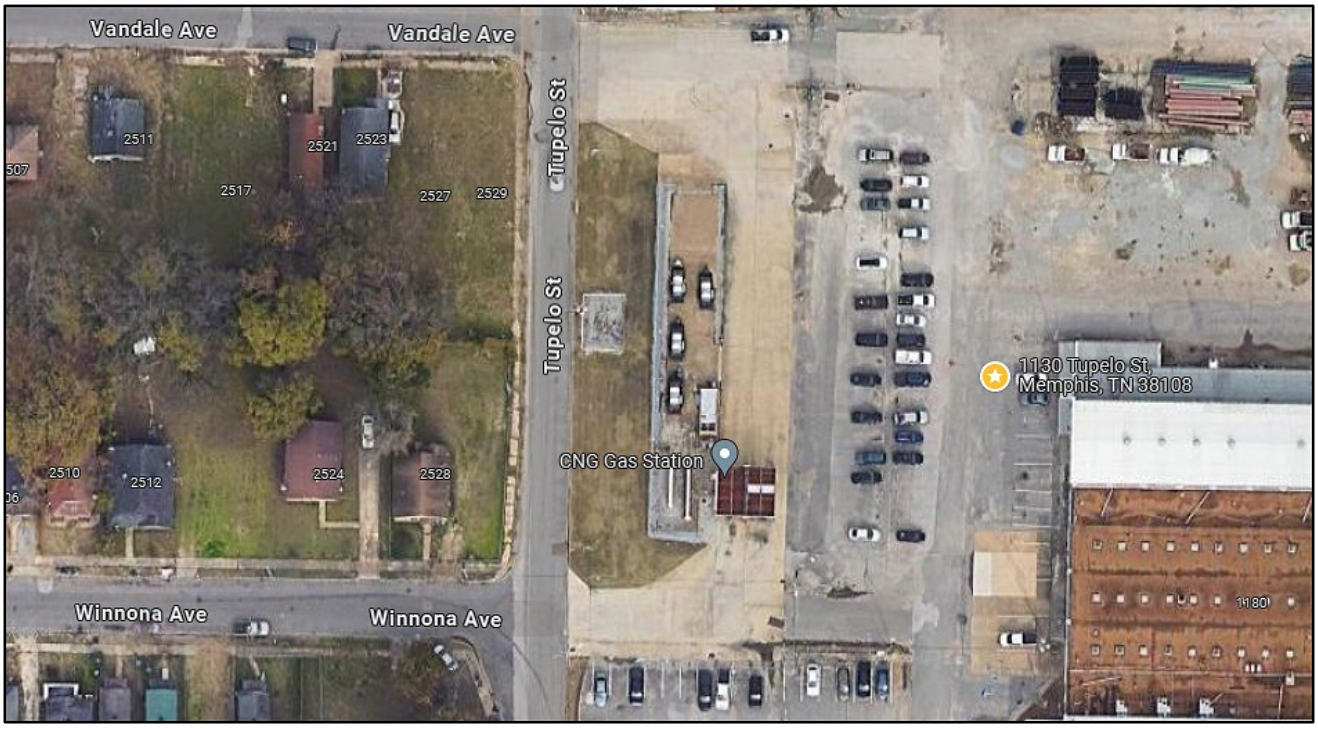

Figure A-3. Piedmont NG, Spence Lane – Nashville

Figure A-4. Clean N' Green – Antioch

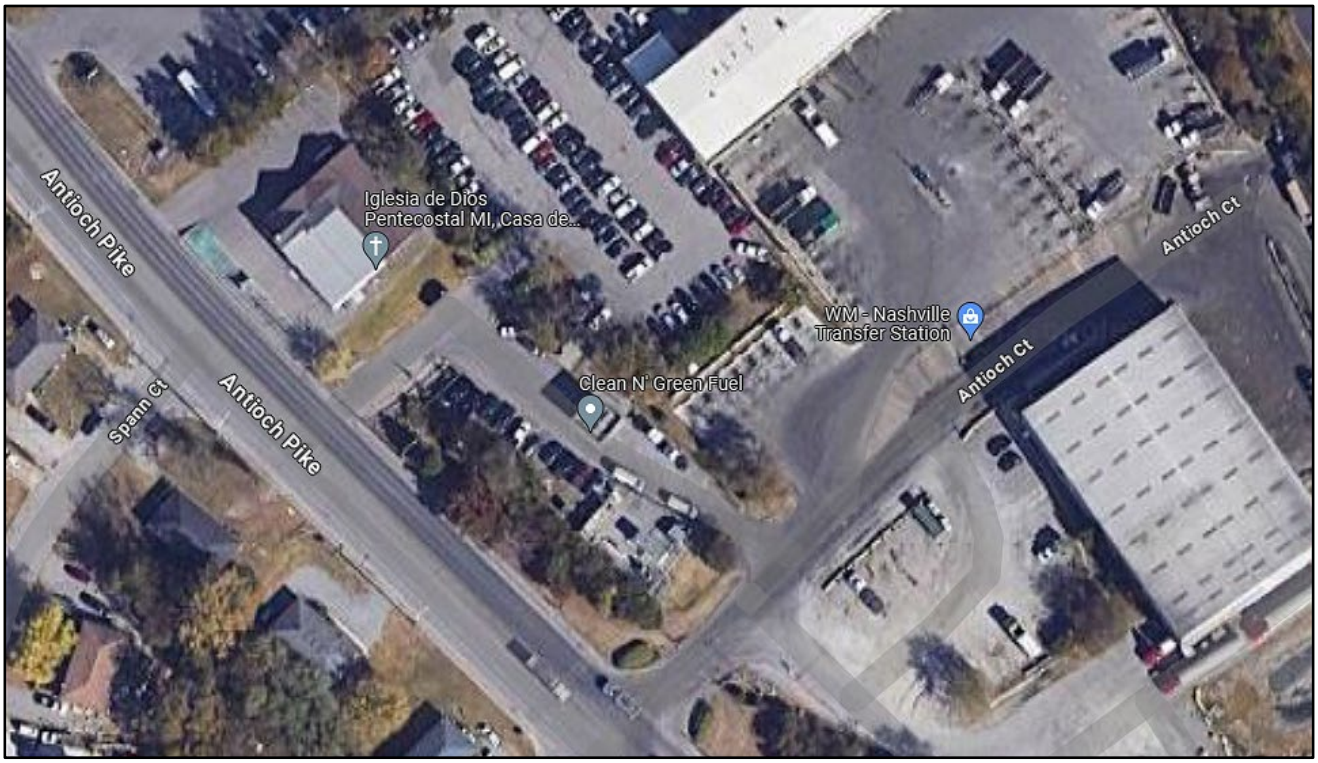

Figure A-5. Beyond6 – Fayetteville

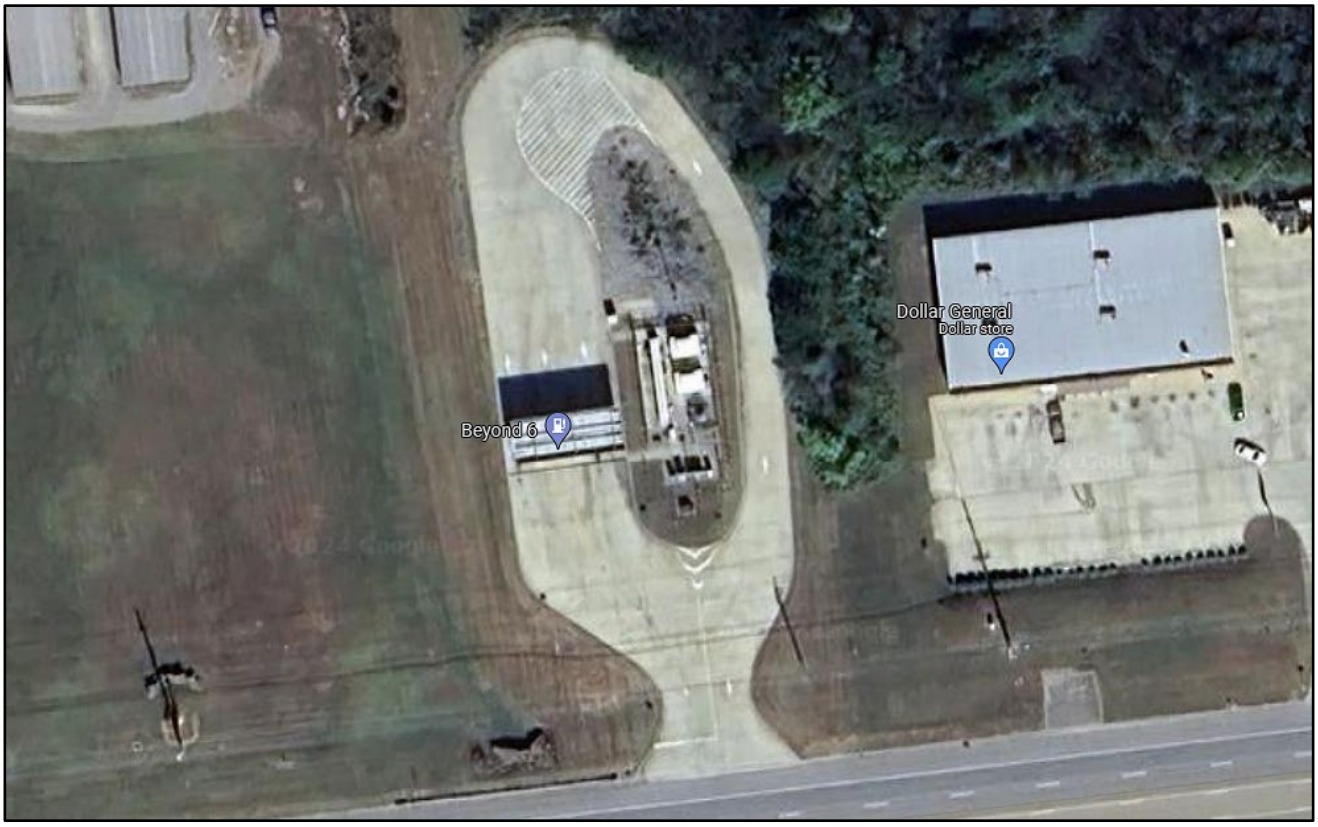

Figure A-6. AUB – Athens

Figure A-7. KUB – Knoxville

Figure A-8. SCUD – Sevierville

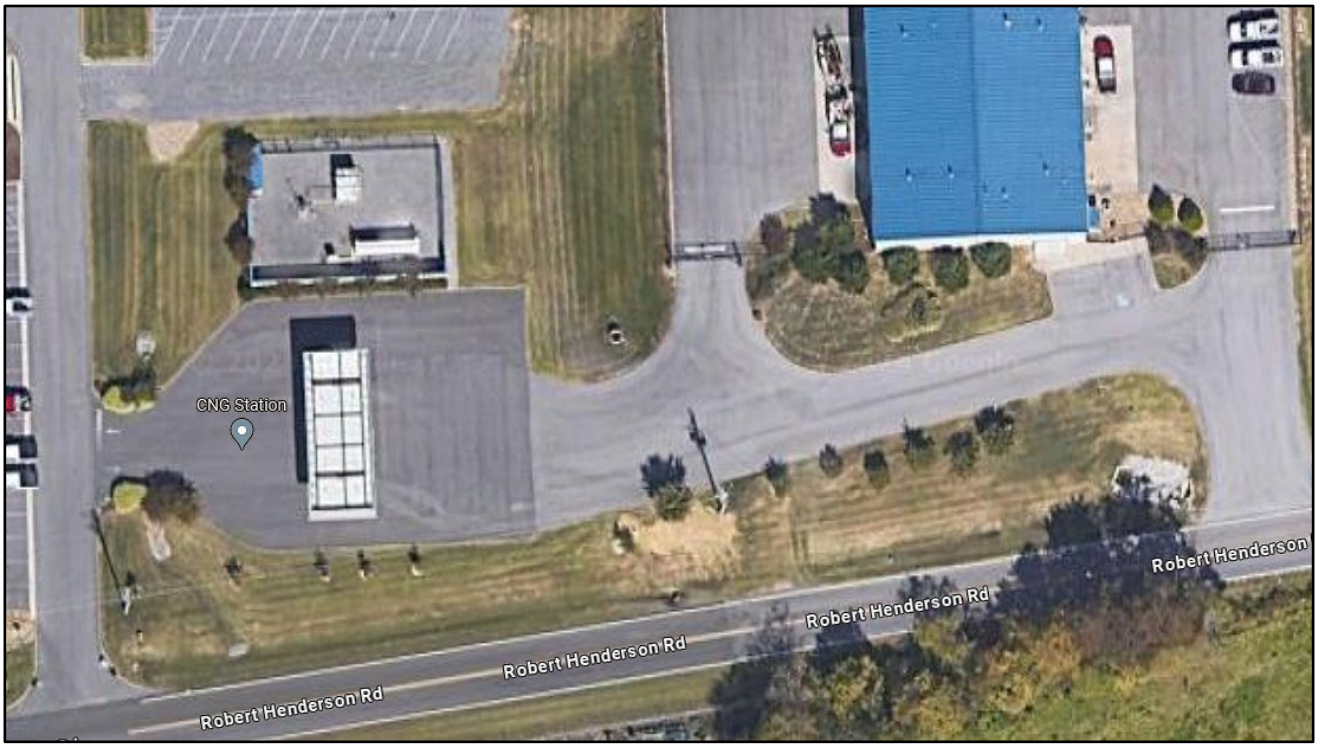
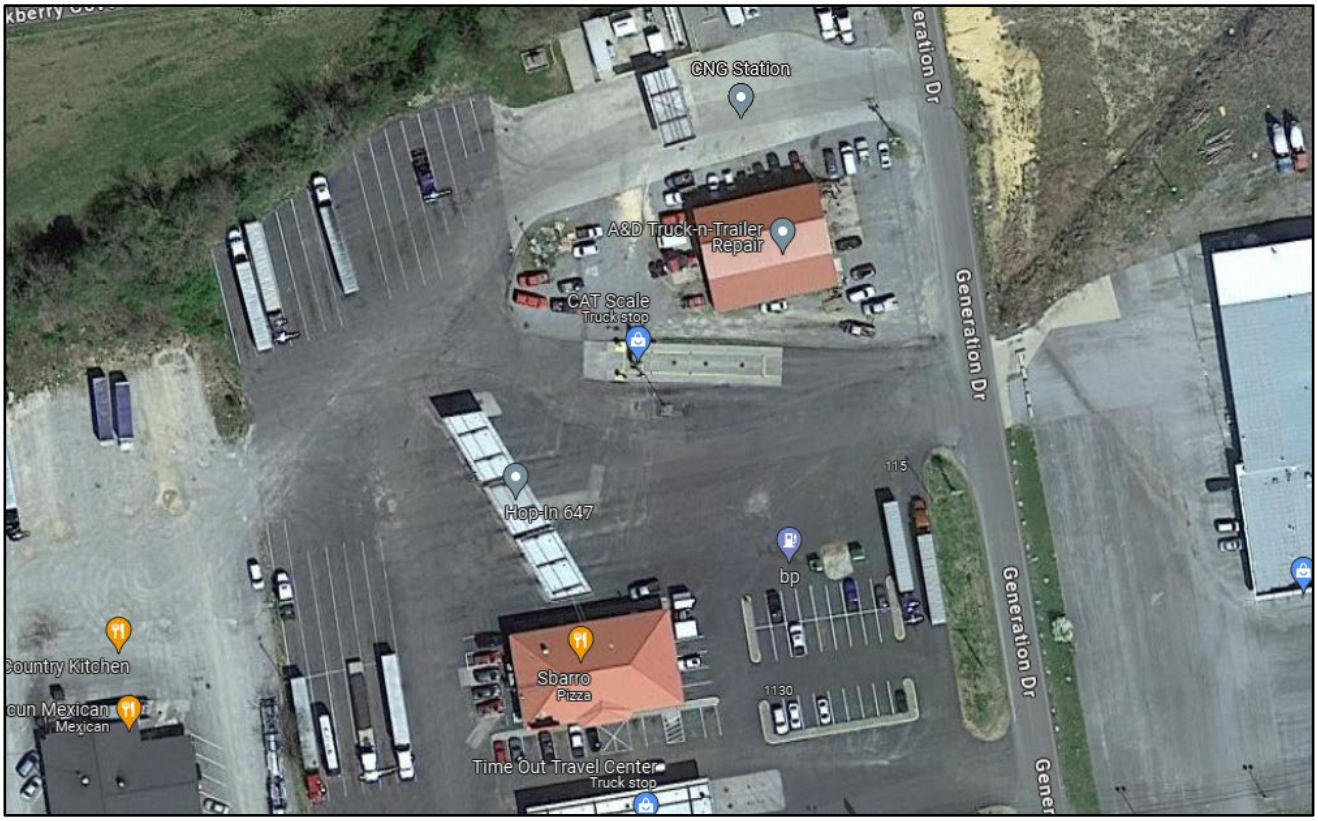
Figure A-9. Beyond6 – Newport