AMERICAN PUBLIC TRANSPORTATION ASSOCIATION

CLEAN PROPULSION RESOURCE GUIDE
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Contents

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1 Overview / Types of Clean Propulsion On-Road Vehicles

The purpose of this Guide is to provide links to useful information on clean propulsion on-road vehicles, infrastructure, and training. (Ctrl+Click to follow links.)

National Transit Database (NTD)

Clean propulsion vehicles (or alternative fuel vehicles) use fuels or propulsion technologies other than diesel or gasoline. This Guide follows the categorization of vehicles by "Mode" and "Power Type" as reported in the FTA's National Transit Database (NTD)[1]. To download vehicle data, select NTD Data Reports, then select 2015 Revenue Vehicle Inventory.

Summary of Clean Propulsion Vehicles – 2015

- The Biodiesel Power Type category was deleted in 2014 – now counted as Diesel Fuel.
- The number of CNG Buses increased 5% from 2014; 18% of all Buses were CNG – no change from 2014.
- The number of Diesel Hybrid Buses increased 12% from 2014; 12% of all Buses were Diesel Hybrid.
- The number of Electric Battery Buses increased 41% from 2014; 0.2% of all Buses were Electric Battery.
- 5% of Commuter Buses were CNG – down 3% from 2014, 5% were Diesel Hybrid – up 1%.
- 4% of Demand Response Vehicles were CNG – no change from 2014, and 1% were Propane.

Table 1 – 2015 U.S. Active Vehicles by Mode and Power Type[2]

	Mode									
Power Type	**Bus**	**%**	**Commuter Bus**	**%**	**Demand Response**	**%**	**Trolley Bus**	**%**	**Van Pool**	**%**
CNG	11,447	18.1%	286	5.1%	1,355	4.1%				
Diesel Hybrid (Diesel & Electric Battery)	7,303	11.6%	294	5.2%	14	0.0%				
Diesel Fuel	41,008	64.9%	4,930	87.1%	8,099	24.6%			67	0.4%
Dual Fuel	47	0.1%			32	0.1%				
Electric Battery	114	0.2%							25	0.2%
Electric Propulsion (3rd Rail or Catenary)	31	0.0%					618	100%		
Ethanol	7	0.0%			16	0.0%				
Gasoline	2,172	3.4%	149	2.6%	22,635	68.8%			15,291	99%
Gasoline Hybrid (Gasoline & Electric Battery)	196	0.3%			346	1.1%			21	0.1%
Hydrogen	20	0.0%								
LNG	580	0.9%			50	0.2%				
Propane	249	0.4%			334	1.0%				
Total	**63,174**		**5,659**		**32,881**		**618**		**15,404**	

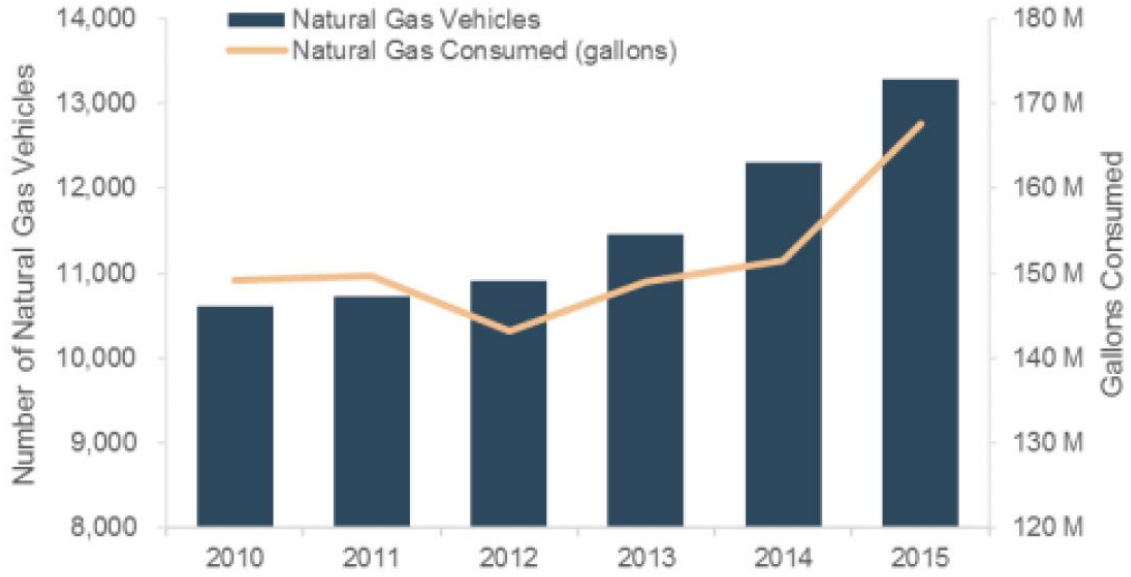
[1] FTA grantees are required to submit data to the NTD. The data primarily focuses on levels of service, capital expenses, operating expenses and sources of funding.

[2] Rural NTD data is not included.

The FTA analyzes NTD data and provides an annual report known as the *NTD National Transit Summary and Trends* (NTST or Storylines) [3] with a separate *NTST Appendix*.

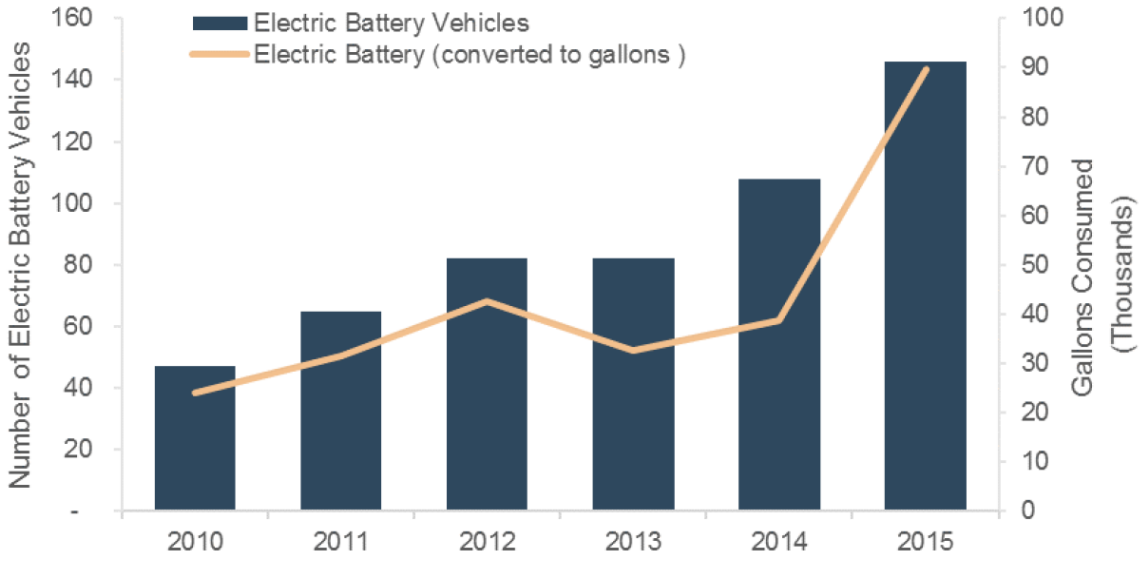
According to the FTA, the number of transit vehicles using natural gas has increased 25.1% since 2010. Over those same six years, natural gas consumption has increased 12.3%.

Figure 1 – Number of Natural Gas Vehicles and Natural Gas Consumed



The number of transit vehicles solely powered by electric battery has increased 211% since 2010. The consumption of electric power (in kilowatt-hours) has increased by 272%.

Figure 2 – Number of Electric Battery Vehicles and Electricity Consumed



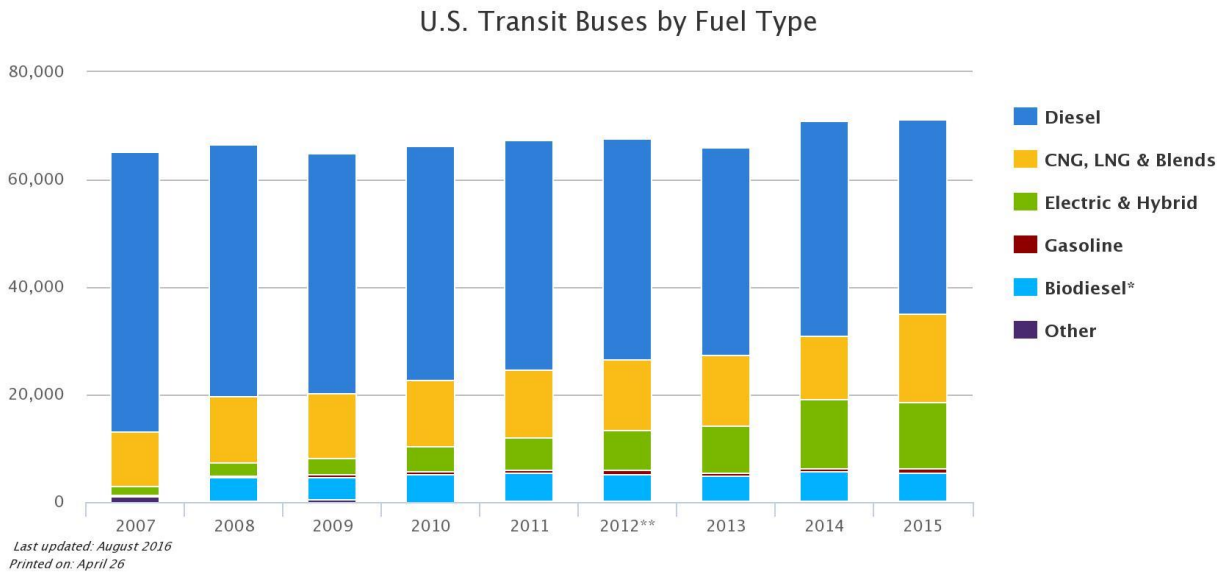
[3] 2015 Report Year NTD Summaries and Trends, p. 30-32, October 2016.

APTA's Fact Book and Public Transportation Vehicle Database
APTA's Fact Book is available as a free download from APTA's website. Vehicle data and energy usage data by Mode and Power Type are based on data from the NTD and from APTA's Public Transportation Vehicle Database. Also available on the same webpage is Fact Book Appendix A, which provides historical vehicle data and energy usage data by Mode and Power Type.

APTA's *Public Transportation Vehicle Database*[4], which is available as a free download to APTA members at the APTA Bookstore, provides additional vehicle information. A special section on the new vehicle market includes orders, planned orders, prior year deliveries, and vehicle costs. However, APTA's Database includes less than 34,000 Buses, whereas FTA's NTD includes over 61,000. (Click on the link and download the zip file, which includes the pdf report. Vehicle data is located in the 'Fleets' file.)

The U.S. Department of Energy (DOE) Alternative Fuels Data Center (AFDC) and the National Renewable Energy Laboratory (NREL)
The following AFDC chart shows the historical trend in the use of alternative fuels in transit buses.[5]

Figure 3 - US Transit Buses by Fuel Type



[4] APTA members are asked to voluntarily submit vehicle data for APTA's *Public Transportation Vehicle Database*. The totals in the summary tables are not national totals since they include only the vehicles of transit agencies included in this database. A number of agencies did not report in 2015. Reports are published annually in June.
[5] Reprinted from U.S. DOE AFDC

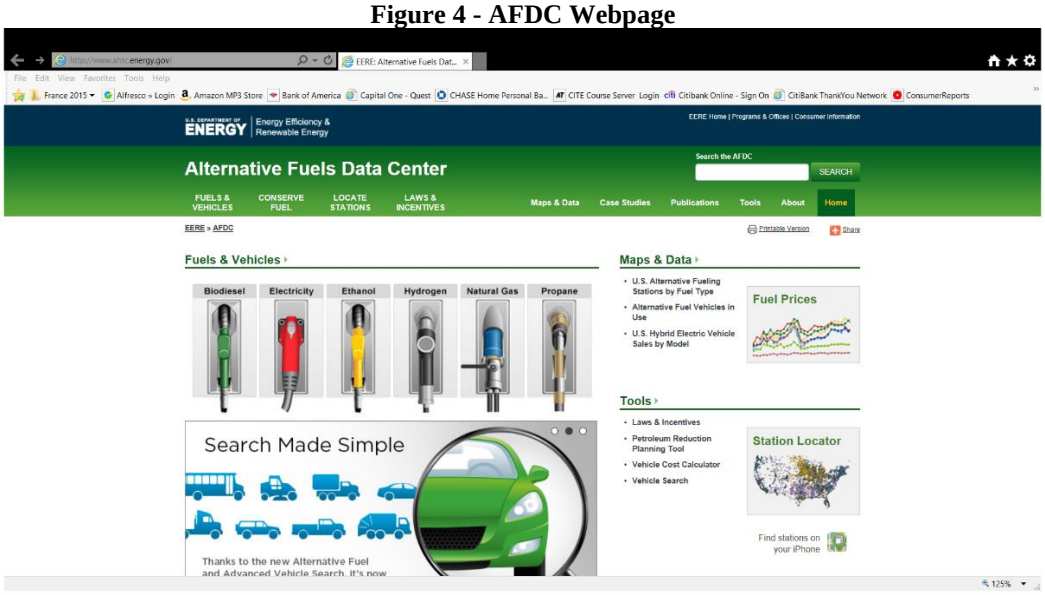
Source: American Public Transportation Association Fact Book Derived from Table 21 and 34 in Appendix A of Edition 2016.

Notes: Biodiesel was counted in the "other" category until 2008. Current numbers do not indicate methodology for defining what blend qualifies a bus as biodiesel and discretion is advised in the use of these numbers beyond basic trend analyses.

2012 vehicle power source percentages were not available from the Public Transportation Fact Book, so an average of 2011 and 2013 power source percentages in combination with the number of transit buses in 2012 is used in place of the missing values.

The AFDC provides a large resource for objective information on alternative fuels. AFDC Publications offers thousands of documents related to alternative fuels and advanced vehicles.

Figure 4 - AFDC Webpage



The alternative fuels presented on the AFDC website are: Biodiesel, Electricity, Ethanol, Hydrogen, Natural Gas, and Propane. For each alternative fuel, the topics covered include:

- The Basics
- Benefits and Considerations
- Stations
- Vehicles
- Laws and Incentives

NREL spearheads transportation research on: electric, hybrid, fuel cell, and conventional vehicle technologies; biofuels, hydrogen, natural gas, propane, and petroleum-based fuels; and charging and fueling infrastructure. NREL Publications include their Fleet Test and Evaluation Reports.

Some specific links on the AFDC and NREL sites of interest to transit:

- Advanced Vehicle Search: includes buses
- Case Studies
- AFDC offers a large collection of helpful tools: calculators, interactive maps, and data searches, to assist decision makers in their efforts to reduce petroleum use.
  http://www.afdc.energy.gov/tools
- NREL also offers Data and Tools for those interested in advanced transportation technologies,
  https://www.nrel.gov/transportation/data-tools.html, such as
  Battery Lifetime Analysis and Simulation Tool (BLAST), and
  Hydrogen Financial Analysis Simulation Tool (H2FAST)
- For those interested in renewable energy for facilities, a suite of tools for calculating performance and cost.
  http://www.nrel.gov/analysis/models_tools.html
- Publications database – including reports from all DOE labs.
  http://www.osti.gov/home/
- Renewable energy resource maps
  http://www.nrel.gov/gis/maps.html

In addition, there are several other resources where independent information, studies and reports are available.

- *Comparison of Modern CNG, Diesel and Diesel Hybrid-Electric Transit Buses: Efficiency & Environmental Performance (Nov. 2013),* looks at fuel economy and emissions data collected by the Altoona Bus Research & Testing Center under the FTA's new model bus testing program. M.J Bradley & Associates provides advice on energy and environmental matters.
- *Clean Diesel versus CNG Buses: Cost, Air Quality, & Climate Impacts (Feb. 2012),* evaluates the potential for life-cycle cost savings to transit agencies from the purchase of new CNG buses instead of new diesel buses. The Clean Air Task Force is a non-profit organization advocating for the deployment of climate-protecting technologies.

Another comprehensive resource is the workshop presentation, *Advance Clean Transit (May 2015)* from the California Air Resources Board (ARB or CARB). The presentation covers: California's alternative fuel and zero emission fleets; regulations; manufacturers and charging times of battery electric buses; manufacturers and fueling times of hydrogen fuel cell buses; engine certification standards; and cost and funding comparisons. See additional information on California's regulations in Section 11.3 California.

The Bus Testing Program at Penn State's Larson Institute (Altoona Bus Research and Testing Center)
https://www.transit.dot.gov/research-innovation/bus-testing

FTA's New Model Bus Testing Program (often referred to as "Altoona Testing" due to the location of the primary test facility) tests new transit bus models, including clean propulsion models, for safety, structural integrity and durability, reliability, performance, maintainability, noise, and fuel economy. Test results for a particular bus model are compiled in a report. An FTA grantee must certify that it has received a copy of the test report prior to final acceptance of the first vehicle.

Figure 5 - Larson Institute Test Track

Through March 2016, over 444 new bus models have been tested. By testing new bus models before they are purchased, grantees and manufacturers can often address problems before the fleet is built, potentially saving considerable money and time and avoiding inconveniencing passengers. The Bus Testing Reports have recently been made available online through the on-line database (control+click on the link), where they can then be searched and filtered to facilitate comparisons between different bus models.

Learn more about the Altoona Bus Research and Testing Center and The Larson Institute Test Track at the Altoona Bus Test website.

2 Biodiesel Vehicles

2.1 Description of Technology

Biodiesel is made primarily from soybeans and other organic products. Biodiesel can be blended with petroleum diesel fuel, typically 20% biodiesel and 80% petroleum diesel known as B20.

Biodiesel use in the United States has increased substantially, growing from about 10 million gallons in 2001 to nearly 1.4 billion gallons in 2013 and 2014. Some fleet use of biodiesel blends is required by federal or state mandates.[6]

Other renewable diesel fuels such as Hydrogenation-Derived Renewable Diesel (HDRD) are produced by processes different than Biodiesel. For an introduction to other renewable diesel fuels see the U.S. DOE AFDC webpage, scroll to the bottom of the page and click on Biodiesel and Other Renewable Diesel Fuels, or check out the San Francisco MTA news article.

2.2 OEMs and Suppliers

The National Biodiesel Board (NBB) is the national trade association representing the Biodiesel industry. The National Biodiesel Board website provides help with locating a Biodiesel retailer, as well as fact sheets on standards, OEM warranties, and the storage, handling and use of Biodiesel.

Engine manufacturers set specifications for fuels and lubricants to be used in their engines, which may go beyond ASTM standard specifications. Users should follow manufacturers' specifications in order to protect their warranty.

- Cummins Engine Company answers Frequently Asked Questions regarding Biodiesel on their website.

ASTM International sets standards for fuel quality. Specifications can be purchased online.

- ASTM D7467, Standard Specification for Diesel Fuel Oil, Biodiesel Blend (B6 to B20)
- ASTM D6751, Standard Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels
- ASTM D975, Standard Specification for Diesel Fuel Oils

2.3 Transit Customers Using Technology

Following is a list of some of the largest users of Biodiesel, Renewable Diesel, and Biodiesel-Electric Hybrid vehicles.

- San Francisco Municipal Transportation Agency (SFMTA), San Francisco, CA – Renewable Diesel
- Metro Transit, Minneapolis, Minnesota
- Tri-County MTD (Tri-Met), Portland, Oregon
- Societe de Transit de Montreal, Quebec
- Kitsap Transit, Bremerton, Washington
- Regional Transport Commission of Southern Nevada, Las Vegas, Nevada
- Brampton Transit, Brampton, Ontario

NREL produces detailed reports documenting the experience of actual users of biodiesel vehicles.

The U.S. Department of Energy (DOE) Alternative Fuels Data Center (AFDC) provides Case Studies. Go to their website; check the boxes for Biodiesel and Public Transit.

TRB's Transit Cooperative Research Program (TCRP) Synthesis 72: Use of Biodiesel in a Transit Fleet (2007) explored potential benefits offered by biodiesel in order to help transit agencies make informed decisions regarding its use.

2.4 Infrastructure

Biodiesel blends (B5 – B20) for bus fleets can be stored and dispensed with the same equipment as diesel fuel. Refer to the Biodiesel Handling and Use Guide from the US DOE.

[6] The U.S. Energy Information Agency (EIA) provides data on the production and use of Biodiesel in the U.S.

2.5 Training

Training addressing operation, maintenance, and safety is usually provided by the bus OEM and key component suppliers.

The National Biodiesel Board provides an Automotive Technician Online Training Program.

2.6 Standards and Regulations

Under the Renewable Fuel Standard (RFS) program, the EPA sets national standards to encourage the use of renewable fuels, including Biodiesel.

For information on Biodiesel fuel standards, see previous section on OEM's and Suppliers.

3 CNG Vehicles

(includes CNG & Diesel, and CNG & Gasoline)

3.1 Description of Technology

A compressed natural gas (CNG) vehicle is fueled by natural gas stored in high-pressure cylinders. The fuel system reduces the pressure of the gas before it is delivered to the engine. Natural gas engines are spark-ignited engines specifically designed to run on natural gas.

A CNG fuel station compresses the natural gas to be delivered to a fuel dispenser, ready for vehicle fueling.

NGV America is the industry's national trade association. Their website details the features and benefits of natural gas vehicles, and provides comprehensive information on vehicles, fuel stations and government policy.

3.2 OEMs and Suppliers

Major manufacturers offer transit buses designed to run on natural gas. These buses are typically powered by the Cummins Westport 8.9L ISL-G engine that provides torque and horsepower comparable to that of diesel engines. For smaller shuttles and other vehicles, fleets can look to other OEMs and about a dozen small volume manufacturers (SVM) that retrofit new or repower existing fleets to run on natural gas.

All Bus OEM's currently serving the North American Market offer natural gas-powered models, they include:

- Blue Bird Bus – offers a rear-engine CNG school bus
- ElDorado National - California – offers full and mid-size low floor CNG buses
- Gillig – offers full-size low floor CNG buses, CNG BRT buses, and CNG commuter buses
- Motor Coach Industries (MCI) – offers CNG coaches
- New Flyer – offers full-size low floor CNG buses and CNG articulated buses
- Nova Bus – offers full-size low floor CNG buses
- Thomas Built Buses – offers mid and full-size CNG school buses

A partial list of companies that provide components and technologies for natural gas buses are:

- ANGI Energy Systems - Designs and manufactures CNG fueling stations
- Agility Fuel Systems - Provides CNG and LNG vehicle fuel systems
- Clean Energy – Designs, builds, operates and maintains (DBOM) CNG and LNG fueling stations. Manufactures, sells and services equipment used in CNG stations and LNG stations.
- Cummins Westport – CNG internal combustion engines
- Gilbarco – CNG dispensers
- Hexagon Lincoln – CNG Storage Cylinders and fuel storage systems
- Luxfer – CNG Storage Cylinders and fuel storage systems
- Tulsa Gas Technologies – CNG dispensers
- Trillium –Designs, builds, operates and maintains (DBOM) CNG fueling stations.

3.3 Transit Customers Using Technology

Following is a list of some of the largest users of CNG buses.[7]

- Los Angeles County MTA (LA Metro) - 2354 CNG buses – search 'CNG' for Board actions, contract awards, and news.
- Orange County Transportation Authority (OCTA) – 584 CNG buses – operates CNG and LNG buses.
- DART, Dallas, Texas – 373 CNG buses in 2013, 612 in 2015 – see CNG Bus Fact Sheet
- MTA New York City Transit – 506 CNG buses
- WMATA, Washington D.C. – 439 CNG buses - search 'CNG' for Board actions, contract awards, and news.
- San Diego Transit System – 419 CNG buses

[7] Number of CNG buses from NTD 2015 Revenue Vehicle Inventory.

NGV America News provides timely reports on the natural gas vehicle industry. For news on CNG bus and fuel station projects and new regulations, search 'CNG buses'.

The U.S. Department of Energy (DOE) Alternative Fuels Data Center (AFDC) provides Case Studies. Go to their website; check the boxes for Natural Gas and Public Transit.

3.4 Infrastructure

Infrastructure for CNG vehicles includes:

- Natural gas fuel supply and fueling stations
- Facility safety systems: gas detection, ventilation, and protection from ignition sources
- In garage scaffolding, cranes and/or safety harnesses to allow safe access to roof-mounted systems

Technical and Safety Documents regarding infrastructure, codes and training are available at NGV America's website.

The American Gas Association has several reports and resources available on its website including a primer, the CNG Infrastructure Guide. Click on the link and scroll down the page to CNG Infrastructure Guide.

3.5 Training

Training addressing operation, maintenance, and safety is usually provided by the bus OEM and key component suppliers.

Cummins Westport Natural Gas Academy provides online information and videos on their natural gas engines.

The Natural Gas Vehicle Institute (NGVi) trains and consults with NGV industry professionals, fleet managers, drivers, maintenance technicians and other employees how to safely operate and fuel natural gas vehicles, and how to size, design, operate and maintain CNG fueling stations.

Technical and Safety Documents regarding infrastructure, codes and training are available at NGV America's website.

3.6 Standards and Regulations

Natural Gas Systems: Suggested Changes to Truck and Motorcoach Regulations and Inspection Procedures is a report published by the U.S. Department of Transportation (US DOT) Federal Motor Carrier Safety Administration (FMCSA). The report provides specific recommendations for safety inspections of CNG and LNG vehicles.

4 Diesel Hybrid Vehicles (Diesel & Electric Battery)

- includes Gasoline Hybrid Vehicles (Gasoline & Electric Battery)

4.1 Description of Technology

Hybrid electric vehicles (HEVs) are powered by an internal combustion engine and an electric drive motor, which uses energy stored in batteries (or in some cases, ultracapacitors). The extra power provided by a combination of the batteries and the electric motor allows for a smaller engine. HEVs employ regenerative braking, in which the propulsion system recaptures energy normally lost during braking by using the electric motor as a generator and storing the recaptured energy in the battery. The energy from the battery provides extra power during acceleration.[8] Additionally, the batteries can power accessory loads (electrification of mechanical accessory systems) and/or reduce engine idling when stopped, leading to greater vehicle efficiencies and limited engine off operation. Resources for technical information from suppliers are provided below under the headings: Hybrid Electric Drive Systems, Electrification of Mechanical Accessory Systems, and Idle Reduction Technology.

The Electric Drive Transportation Association (EDTA) is the trade association promoting battery, hybrid, plug-in hybrid and fuel cell electric drive technologies and infrastructure. EDTA's website focuses on the automobile EV segment. Search for "buses" and scroll down past the "General Content" to "News Articles."

4.2 OEMs and Suppliers

The following bus OEM's currently serving the North American Market offer Hybrid Electric models:

- ElDorado National - California – offers mid-size low floor Diesel Hybrid buses with Allison or BAE Systems Hybrid Systems
- Gillig – offers full-size low floor Diesel Hybrid buses, BRT buses, and commuter buses with Allison or BAE Systems Hybrid Systems or Voith Electric Drive Systems.
- Motor Coach Industries (MCI) – offers Diesel Hybrid coaches with Allison Hybrid Drive Systems.
- New Flyer – offers full-size low floor Diesel Hybrid buses and articulated buses with Allison or BAE Hybrid Systems.
- Nova Bus – offers full-size low floor Diesel Hybrid buses and articulated buses with BAE Systems or Allison Hybrid Systems.

Hybrid Electric Drive Systems:
Companies producing Hybrid Electric Drive Systems for transit that are commonly in use today in North America and elsewhere are:

- Allison Transmission Inc. - Provides hybrid propulsion systems sold through Bus manufactures. The Allison Hybrid Drive System incorporates a transmission and an electric motor that assists propulsion and captures braking energy. The system is based on the parallel hybrid architecture. (webpage or brochure)

- BAE Systems, HybriDrive® Systems - Provides hybrid propulsion systems sold through Bus manufactures. The BAE Systems HybriDrive System is a series hybrid system that uses an electric motor as the sole means of propulsion. (webpage or brochure)

Other suppliers include:

- Voith – Hybrid Electric Drive Systems
- Eaton – Hybrid Electric Vehicle Systems (webpage or fact sheet)
- Vossloh Kiepe – Hybrid Electric Drive Systems

Electrification of Mechanical Accessory Systems:
The electrification of mechanical accessory systems is aimed at improving vehicle efficiency through the elimination of less efficient mechanical systems on the vehicle such as hydraulically driven and belt driven fans, pumps and compressors.

Many companies, in addition to the suppliers previously mentioned, have various products that are used to accomplish mechanical systems electrification. Generally, companies provide either power sources or electric accessories such as air conditioning systems, engine cooling systems, air compressors, etc. Bus OEMs generally are the ones who integrate the

[8] AFDC webpage, 10/2/15

electric accessory components on the vehicle. A partial list of companies that provide components that support vehicle system electrification follows:

- Allison Transmission – Electrified Accessories (brochure)
- BAE Systems – Electrified Accessories and Accessory Power Systems
- EMP Corp – Electric Cooling Systems
- Grayson Thermal Systems – Chillers and Air Conditioning (website or brochure)
- Modine Corp – Electric Cooling Systems
- Powerex – Electric Air Compressors
- ThermoKing – Electric Air Conditioning (website or brochure)
- Vanner Corp. – Accessory Power Systems

Idle Reduction Technology:
Stop/start or no-idle or idle reduction technology allows the engine to stop when not needed (webpage).

4.3 Transit Customers Using Technology

Following is a list of some of the largest users of hybrid buses.[9]

- MTA New York City Transit – 1675 buses
- King County Metro – Seattle, Washington – 697 buses incl. 120 stop/start[10]
- Toronto Transit Commission (TTC) – 691 buses
- WMATA, Washington, DC – 602 buses
- Southeast Pennsylvania Transportation Authority (SEPTA) – 510 buses
- Maryland Transit Administration (MTA) – 363 buses incl. 10 stop/start
- Chicago Transit Authority (CTA) – 259 buses
- Metro Transit (Minneapolis/St. Paul) – 132 buses
- MBTA, Boston, Massachusetts – 60 stop/start buses
- Miami-Dade Transit (MDT) – 43 buses incl. 6 stop/start
- TriMet, Portland, OR – 8 buses
- Quebec, Canada - 8 buses (webpage with link to video)

NREL produces detailed reports documenting the experience of actual users of hybrid electric vehicles.

4.4 Infrastructure

Infrastructure for Diesel Hybrid vehicles includes:

- In-garage scaffolding, cranes and/or safety harnesses to allow safe access to roof-mounted systems

4.5 Training

Training addressing operation, maintenance, and safety for advanced technology systems is usually provided by the bus OEM and key component suppliers

4.6 Standards and Regulations

[9] Number of hybrid buses from NTD 2014 Revenue Vehicle Inventory.
[10] Number of start/stop hybrid buses from FTA Transportation Program Engineer Patrick Centolanzi, patrick.centolanzi@dot.gov

5 Electric - 3rd Rail or Catenary Vehicles (Trolley Buses)

(includes Diesel & 3rd Rail or Catenary)

5.1 Description of Technology

Electric - 3rd Rail or Catenary Vehicles are conductive or inductive electric vehicles such as electric trolley buses that use electricity from an overhead wire, 3rd rail or from an inductive coil in the ground or track below the vehicle. They are zero emission vehicles.

5.2 OEMs and Suppliers

Bus Manufacturers / OEMs

- TBD

Integrators and Component Suppliers

- ABB (charging systems)
- Eaton (charging systems)
- Efacec (charging systems)
- Siemens (electric drive, electric accessory and charging systems components)
- Vossloh Kiepe (electric traction systems)

5.3 Transit Customers Using Technology

- San Francisco Municipal Transit Agency – electric trolley and dual mode diesel buses

5.4 Infrastructure

Infrastructure for Electric - 3rd Rail or Catenary Vehicles includes:

- Electric service modifications to support vehicle power requirements
- On-route electrical power substations, 3rd rail or catenary
- In garage scaffolding, cranes and/or safety harnesses to allow safe access to roof-mounted systems

5.5 Training

Training addressing operation, maintenance, and safety is usually provided by the bus OEM and key component suppliers

5.6 Standards and Regulations

6 Electric Battery Vehicles

6.1 Description of Technology

Electric Battery vehicles use a battery to store electric energy on the vehicle. They are zero emission vehicles. Recharging is accomplished by direct plug-in, overhead contactor or inductive charging.

The Electric Drive Transportation Association (EDTA) is the trade association promoting battery, hybrid, plug-in hybrid and fuel cell electric drive technologies and infrastructure. EDTA's website focuses on the automobile EV segment. Search for "buses" and scroll down past the "General Content" to "News Articles."

6.2 OEMs and Suppliers

Bus Manufacturers / OEMs

- BYD – Bus OEM (battery electric)
- Complete Coach Works (ZEPS all-electric transit bus retrofit, electric drive system, batteries)
- ElDorado National - Bus OEM – supplying limited deployments
- Gillig – Bus OEM – supplying limited deployments
- New Flyer Corp – Bus OEM (fuel cell and battery electric)
- Nova Bus – Bus OEM (battery electric)
- Proterra – Bus OEM (battery electric)

Integrators and Component Suppliers

- ABB website or pdf - (charging systems, including in-service overhead charging
- BAE Systems - (provides Series-E propulsion system provider for pure Electric Vehicles)
- EFACEC (vehicle electric motorization, batteries, charging interface and charging systems)
- Siemens (electric drive, electric accessory and charging systems components)
- US Hybrid (power conversion and accessory power components, integration services)
- Wave – (supplies inductive charging systems)

6.3 Transit Customers Using Technology

California has been a leading adopter of electric battery buses. See The Transit Fleet Rule.

- IndyGo - Indianapolis, Indiana
- Antelope Valley Transit Authority – Lancaster, California
- Foothill Transit – West Covina, California
- LACMTA (LA Metro), Los Angeles, California
- Long Beach Transit - Long Beach, California
- NY MTA – New York City, NY
- San Joaquin Regional Transit District – Stockton, California
- Stanford University – Stanford, California
- Transit Authority of River City (TARC) – Louisville, Kentucky
- Worcester Regional Transit Authority (WRTA) – Worcester, Massachusetts
- Monterey-Salinas Transit, Monterey, California
- TriMet – Portland, Oregon – ordered 4 buses to be delivered in 2018

6.4 Infrastructure

Infrastructure for Electric Battery vehicles includes:

- Electric service modifications to support vehicle charging
- In-garage charging stations
- On-route ultra-fast charging stations
- In garage scaffolding, cranes and/or safety harnesses to allow safe access to roof-mounted systems

6.5 Training

Training addressing operation, maintenance, and safety is usually provided by the bus OEM and key component suppliers.

6.6 Standards and Regulations

Efforts are ongoing to standardize electric vehicle charging:

- EPRI Infrastructure Working Council (webpage)
- *J2954 Wireless Charging of Electric and Plug-in Hybrid Vehicles*
- J3105 *Electric Vehicle Power Transfer System Using a Mechanized Coupler*
- J3068 *Electric Vehicle Power Transfer System Using a Three-phase Capable Coupler*

7 Ethanol Vehicles (primarily used in Van Pools)

7.1 Description of Technology

Ethanol is a renewable fuel made from plants, mostly corn. Almost all gasoline in the U.S. contains some ethanol, but Ethanol Vehicles or Flexible Fuel Vehicles (FFVs) can use E85—a high-level blend containing 51%-83% Ethanol depending on season and geography. FFVs can use either gasoline or E85 or a mixture of both. FFVs are defined as Alternative Fuel Vehicles and Clean Propulsion Vehicles[11].

NTD responders reported only a small number of transit vehicles as powered by Ethanol. More NTD vehicles are reported as "Dual Fuel," which may include FFVs. On the other hand, responders to APTA's Public Transportation Database, which does not include the Dual Fuel category, reported 3% of Demand Response vehicles and 15% of Van Pool vehicles as ethanol powered.

7.2 OEMs and Suppliers

Search the AFDC vehicle search tool for FFVs from Chevrolet, Ford, GMC and Dodge/Chrysler.

7.3 Transit Customers Using Technology

- King County DOT – Seattle, Washington, reports using 667 Ethanol powered van pool vehicles[12].
- Regional Transit Commission of Southern Nevada – Las Vegas, Nevada, reports 251 Ethanol powered demand response vehicles[13].

7.4 Infrastructure

The AFDC provides information on E85 equipment options, and equipment installation.

7.5 Training

Training addressing operation, maintenance, and safety is usually provided by the vehicle OEM and key component suppliers.

7.6 Standards and Regulations

AFDC provides information on codes, standards and regulations regarding the use of Ethanol.

Under the Renewable Fuel Standard (RFS) program, the EPA sets national standards to encourage the use of renewable fuels, including Ethanol.

[11] For fleets that have to comply with federal acquisition regulations, flexible fuel vehicles are considered alternative fuel vehicles (AFVs) under the Energy Policy Act of 1992. (AFDC website, 9/30/15)
[12] 2014 APTA Public Transit Vehicle Database
[13] 2014 APTA Public Transit Vehicle Database

8 Hydrogen Vehicles (Fuel Cell Vehicles)

(including Hythane CNG & H2)

8.1 Description of Technology

Fuel cell electric vehicles use stored hydrogen to create electricity. They are zero emission vehicles.

The Electric Drive Transportation Association (EDTA) is the trade association promoting battery, hybrid, plug-in hybrid and fuel cell electric drive technologies and infrastructure. EDTA's website focuses on the automobile EV segment. Search for "buses" and scroll down past the "General Content" to "News Articles."

NREL produces detailed reports on hydrogen fuel cell bus projects.

U.S. DOE publishes an annual report, *State of the States: Fuel Cells in America*, prepared by the Fuel Cell and Hydrogen Energy Association (FCHEA), which is a trade association promoting fuel cell and hydrogen technology.

8.2 OEMs and Suppliers

Bus Manufacturers / OEMs

- ElDorado National – Bus OEM (fuel cell and battery electric)
- New Flyer Corp – Bus OEM (fuel cell and battery electric)

Integrators and Component Suppliers

A partial list of companies that provide components and technologies for natural gas buses are:

- Air Products –Hydrogen manufacturing, storage and dispensing
- BAE Systems (electric drive solutions, electric accessory power systems, integration services)
- Ballard Power Systems (fuel cell engines)
- Hydrogenics (fuel cell engines)
- Linde – Hydrogen production, storage and dispensing.
- Siemens (electric drive, electric accessory and charging systems components)
- US Fuel Cell (fuel cell engines)
- US Hybrid (power conversion and accessory power components, integration services)
- Vossloh Kiepe - (hybrid electric drive systems)

8.3 Transit Customers Using Technology

- AC Transit – Oakland – Fuel Cell
- Mass Transportation Authority, Flint – Fuel Cell
- Massachusetts Bay Transportation Authority – Fuel Cell
- Orange County Transit Authority, Orange, CA – Fuel Cell
- Stark Area Regional Transit Authority – Fuel Cell
- SunLine Transit – Fuel Cell
- University of California, Irvine – Fuel Cell

8.4 Infrastructure

Infrastructure for Hydrogen Fuel Cell vehicles includes:

- Gaseous hydrogen fuel supply and fueling stations
- Facility safety systems: gas detection, ventilation, and protection from ignition sources
- In garage scaffolding, cranes and/or safety harnesses to allow safe access to roof-mounted systems

8.5 Training

Training on operation, maintenance, and safety is usually provided by the bus OEM and key component suppliers

The California Fuel Cell Partnership (CaFCP) can organize and provide training for users of H2 fuel.

8.6 Standards and Regulations

9 LNG Vehicles

9.1 Description of Technology

Liquefied natural gas (LNG) is produced by cooling natural gas to temperatures below -260° F. In order to keep LNG cold, it is stored in thermally insulated storage tanks at the fuel station and on-board the vehicle. LNG vehicles use the same engines as CNG vehicles. When the engine in a LNG vehicle is started, the LNG is heated, converting it back to a gas for use in the engine.

NGV America News provides timely reports on the natural gas vehicle industry. For news on LNG bus and fuel station projects and new regulations, search 'LNG buses'.

9.2 OEMs and Suppliers

- Agility Fuel Systems - Provides CNG and LNG vehicle fuel systems
- Clean Energy – Designs, builds, operates and maintains (DBOM) CNG and LNG fueling stations. Manufactures, sells and services equipment used in CNG stations and LNG stations.
- Linde – LNG production, storage and dispensing.

9.3 Transit Customers Using Technology

- Orange County Transportation Authority (OCTA) – operates CNG and LNG buses. Follow link for 2013 Staff Report on LNG fuel contract.

NREL produces detailed reports documenting the experience of actual users of LNG vehicles.

9.4 Infrastructure

Infrastructure for LNG vehicles includes:

- LNG fuel supply and fueling stations
- Facility safety systems: gas detection, ventilation, and protection from ignition sources
- In garage scaffolding, cranes and/or safety harnesses to allow safe access to roof-mounted systems

A report titled, *Liquefied Natural Gas Infrastructure (TIAX, 2013)*, is available on the American Gas Association (AGA) website.

9.5 Training

Training addressing operation, maintenance, and safety is usually provided by the bus OEM and key component suppliers

9.6 Standards and Regulations

In addition to other NFPA Codes (see Section 11.2), NFPA 57 Liquefied Natural Gas (LNG) Vehicular Fuel Systems Code specifically addresses LNG vehicles.

In January 2015, the New York State Department of Environmental Conservation (DEC) issued regulations for the siting of new LNG facilities in the state.[14]

[14] NGV America News, Feb. 3, 2015

10 Propane Vehicles

10.1 Description of Technology

Propane autogas is an available choice in the cutaway space for para-transit applications. Propane is 90% domestically sourced (most derived from natural gas) and offers several potential benefits:

- Potentially lower cost of ownership
- Potentially little to no cost for infrastructure
- Minimal upgrades to shop if location is to code for gasoline/diesel
- Some vehicle may offer range in excess of 250 miles depending on usage
- Altoona tested
- Technology available across 2 main chassis cutaway options from Ford & GM

10.2 OEMs and Suppliers

All major cutaway OEM's are working with second stage upfitters to install chassis OEM endorsed propane or CNG systems. ASV which owns several manufacturers including Champion, Goshen & Eldorado recently announced a relationship with CleanFuel USA for propane systems on GM chassis and Westport for CNG solutions on the Ford and GM Chassis.

ROUSH CleanTech works exclusively as an approved gaseous fuels QVM with Ford and supplies propane systems via GAS and A-1 to the bus manufacturers

10.3 Transit Customers Using Technology

- San Diego MTS, San Diego, CA
- Flint Mass Transit Authority, Flint, MI
- GCRTA: Cleveland, Ohio
- Broward Transit, Broward, FL
- Kitsap Transit, WA State
- CARTS: Austin, TX
- DART: Dover, DE
- Columbia, Columbia, SC
- Palm Tran, Palm Beach, FL
- SMART: Detroit, MI

10.4 Infrastructure

10.5 Training

Training addressing operation, maintenance, and safety is usually provided by the bus OEM and key component suppliers.

The following websites provide information on training in the use of propane vehicles.

- www.roushcleantech.com
- www.cleanfuelusa.com
- www.autogasusa.org
- www.propanecouncil.org
- www.npga.org

10.6 Standards and Regulations

With propane, the major issue is education in the differences between propane and CNG so that local authorities understand how to guide transit agencies on proper set up of service facilities, tech training, and first responders. Many of the tools already exist to answer these questions but since there is no national guidance it allows for interpretation at a local level.

Resources:

- Technology Council within the Propane Education and Research Council: Michael Taylor/Director of Autogas Business Development
- ROUSH CleanTech Customer Advisory Panel: Todd Mouw, VP of Sales & Marketing
- National Propane Gas Association: Phil Squair: Senior VP of Government Affairs

11 Standards, Codes and Regulations

The following is a sampling of organizations and issues regarding standards, codes and regulations impacting Clean Propulsion vehicles.

11.1 Federal Transit Administration

Buy America Regulation (49 CFR Part 661)

FTA's Buy America regulation requires that the steel, iron, and manufactured goods used in the project are produced in the United States. Specifically, the cost of the components and subcomponents produced in the U.S. must be more than:

- 60 percent for FY2016 and FY2017
- 65 percent for FY2018 and FY2019
- 70 percent for FY2020 and beyond

Final assembly for rolling stock (transit buses are included in the FTA's definition of rolling stock) also must occur in the U.S. (See FAST Act fact sheet.) An FTA grantee must require in its bid or request for proposal (RFP) that the bidder or offeror submit a completed Buy America certificate.

Bus Testing Regulation (49CFR Part665)

An FTA grantee must certify that any new bus model acquired, including clean propulsion models, has been tested, and that the grantee has received a copy of the test report prior to final acceptance of the first vehicle. This part contains the information necessary for a recipient to ensure compliance with this provision.

11.2 U.S. Environmental Protection Agency (EPA)

Heavy-Duty National Program

In 2011, EPA and NHTSA adopted a first-ever program to reduce greenhouse gas emissions and improve fuel efficiency of medium- and heavy-duty vehicles, including clean propulsion transit buses (the Greenhouse Gas Rule). For more information, see the EPA announcement.

A second phase of regulations is planned for model years beyond 2018. See the EPA website for more information.

EPA Green House Gas Rule also has various OBD heavy duty hybrid related requirements as well as emissions level requirements for heavy duty engines.

The EPA also promulgates regulations and standards affecting transit buses through its Heavy-Duty Diesel Highway Program.

11.3 Other National Issues

Axle Weight

Bus axle weights and overweight buses have been a topic of concern for many years. The issue is of particular concern to Clean Propulsion Vehicles, which have a higher curb weight that traditional vehicles due to the added weight of alternative fuel systems and/or energy storage systems (batteries). A recent study was conducted for the American Public Transportation Association with funding provided through the Transit Cooperative Research Program (TCRP) Project J-11. This study conducted by MORR Transportation Consulting Ltd. Resulted in a report entitled *An Analysis of Transit Bus Axle Weight Issues (November 2014)*.

11.4 California

The Transit Fleet Rule

The California Air Resources Board (ARB or CARB) promulgated the Transit Fleet Rule, which requires reductions in both pollutant emissions from urban buses and transit fleet vehicles. The transit fleet rule also established a demonstration and purchase requirement of zero emission technologies for large transit agencies. Some transit agencies are actively operating and demonstrating zero emission fuel cell and battery electric buses. ARB's website includes comprehensive information on Urban Bus and Transit Fleet Vehicle Requirements, Transit Regulations, and Bus Engine Emissions Standards.

The zero emission bus purchase requirement is currently on hold. Staff is conducting a technical assessment and is planning amendments to the transit fleet rule. These amendments would further reduce criteria pollutant and greenhouse gas emissions from transit fleet vehicles while continuing to foster zero emission technologies.

ARB holds regular workshops. Follow the link to the ARB presentation, Advanced Clean Transit (May 2015), which provides information on the Transit Fleet Rule. The presentation also details the battery electric and hydrogen fuel cell transit bus fleets operating in California, and the distribution of alternative fuel buses in California.

OBD and ARB Certification
Recent regulatory language has required heavy duty hybrid truck and buses being sold into California to have certification that includes OBD (Onboard Diagnostics) compliance. OBD requirements for heavy duty are contained in Title 13 California Code of Regulations 1971.1. California requires an Executive Order by the Air Resources Board (ARB) for any heavy duty vehicle sale in California including hybrids. Additional information about OBD and the ARB certification process can be found by searching www.arb.ca.gov.

11.5 NFPA (National Fire Protection Association)

Publishes fire safety codes and standards, which are available free online.
Key standards and codes include:

- NFPA 52: Vehicular Gaseous Fuel Systems Code - covers the design, installation, operation, and maintenance of CNG and LNG fuel systems on all vehicle types--plus their respective compression, storage, and dispensing systems.
- NFPA 30A: Code for Motor Fuel Dispensing Facilities and Repair Garages - Coverage includes storage of liquids; piping for liquids; fuel dispensing systems; building construction requirements; electrical installations; operational requirements; vapor processing and recovery systems for liquid motor fuels; and requirements for CNG, LNG, hydrogen, and LPG

11.6 SAE

SAE J1939 Standards are maintained by the SAE Truck and Bus Control and Communications Network Committee. SAE Contact: Jana Wright (jwright@sae.org)

- Members of this committee get broad exposure to heavy duty vehicle systems and communications as well as covering interfaces for hybrids and other vehicle systems. Regulatory compliance for Onboard Diagnostics and diagnostic tool related information are also discussed.
- Hybrid Communications Task Force of the SAE J1939 Standard Committee. This task force is working on standard interfaces for heavy duty hybrid and electric vehicles. Industry members of this task force are producers of heavy duty hybrid vehicle components and related tools.

Efforts are ongoing to standardize electric vehicle charging:

- EPRI Infrastructure Working Council webpage
- *J2954 Wireless Charging of Electric and Plug-in Hybrid Vehicles*
- J3105 *Electric Vehicle Power Transfer System Using a Mechanized Coupler*
- J3068 *Electric Vehicle Power Transfer System Using a Three-phase Capable Coupler*

12 Legislation and Funding

12.1 APTA Legislative Resources

APTA provides regular updates on legislative and regulatory changes in their periodical ***"Passenger Transport."*** They also provide a legislative reference on their website through their page entitled ***"Governmental Affairs and Policy."*** For a link to this page please go to:

http://www.apta.com/GAP/Pages/default.aspx

12.2 Federal Transit Administration Legislative and Funding Resources

The FTA maintains a webpage where FTA Rules are linked to the Federal Register website. To learn more about FTA Rules, choose a document type, topic, or conduct a title search by keyword. Results will include a summary of the Rule and a link to the PDF of the appropriate Federal Register page.

https://www.transit.dot.gov/regulations-guidance/rulemaking

The FTA maintains a comprehensive on-line library of documents. Documents in the library are found through the FTA Public Web. The Library is organized into topic sections and includes a section on Legislation and Law. For a link to the FTA Library, please go to:

http://www.fta.dot.gov/about/library.html

FTA Grant Programs
Under the **Buses and Bus Facilities Formula Program – 5339(a)**, the FTA provides formula funding for capital projects to replace, rehabilitate and purchase buses, vans, and related equipment, and to construct bus-related facilities. In addition to the formula allocation, this program includes two discretionary components: The Bus and Bus Facilities Discretionary Program and the Low or No Emissions Bus Discretionary Program.

Under the **Buses and Bus Facilities Discretionary Program – 5339(b)**, the FTA provides discretionary funding through competitive grants for capital projects to replace, rehabilitate and purchase buses, vans, and related equipment, and to construct bus-related facilities. In FY 2016, $211 million is available. The deadline for applying for a grant is May 13, 2016. See the FTA Notice of Funding Opportunity (NOFO) for more information.

Under the **Low or No Emission Discretionary Program - 5339(c)**, the FTA provides discretionary funding through competitive grants for capital acquisitions of zero emission and low-emission transit buses, including supporting facilities such as recharging, refueling, and maintenance facilities. In FY 2016, $55 million is available. The deadline for applying for a grant is May 13, 2016. See the FTA Notice of Funding Opportunity (NOFO) for more information.

The FTA provides guidance on applying for and administering grants.

https://www.transit.dot.gov/regulations-and-guidance/regulations-and-guidance

For additional information about the Grant Programs, contact the FTA Office of Program Management: (202) 366-2053. For more information about clean fuels in the transit industry, contact the Office of Research, Demonstration and Innovation at (202) 366-4052.

12.3 California Legislation and Funding Programs

California has created a comprehensive program to reduce greenhouse gas emissions, including a Cap-and-Trade Program and a Greenhouse Gas Reduction Fund.

The California Department of Transportation (Caltrans), which is a department within the new (2013) California State Transportation Agency (CalSTA), administers the Low Carbon Transit Operations Program (LCTOP), which provides

operating and capital assistance for transit agencies to reduce greenhouse gas emissions and improve mobility, including the purchase of zero emission or hybrid vehicles.

Caltrans also administers the Transit and Intercity Rail Capital Program, which provide monies to fund capital improvements and operational investments that will reduce greenhouse gas emissions and improve rail service. Bus projects that improve rail service are eligible by achieving greenhouse gas reductions through the use of zero and near zero-emission buses.

13 2017 APTA Bus and Paratransit Conference Clean Propulsion Committee Legislative Update

https://www.transit.dot.gov/legislation

Recent Rulemaking Highlights
Complete List: https://www.transit.dot.gov/regulations-guidance/rulemaking

Bus Testing: Establishment of Performance Standards, a Bus Model Scoring System, a Pass/Fail Standard and Other Program Updates; Final Rule Published 08/01/16, Effective 10/31/16

Summary: The Federal Transit Administration (FTA) is issuing a new pass/fail standard and new aggregated scoring system for buses and modified vans that are subject to FTA's bus testing program, as mandated by Section 20014 of the Moving Ahead for Progress in the 21st Century Act (MAP-21). The pass/fail standard and scoring system address the following categories as required by MAP-21: Structural integrity, safety, maintainability, reliability, fuel economy, emissions, noise, and performance. Recipients of FTA grants are prohibited from using FTA financial assistance to procure new buses that have not met the minimum performance standards established the final rule. Finally, FTA is requiring bus manufacturers to provide country-of-origin information for test unit bus components, in lieu of applying Buy America U.S. content requirements to all buses submitted for testing.

Notice of Policy on the Implementation of the Phased Increase in Domestic Content Under the Buy America Waiver for Rolling Stock and Notice of Public Interest Waiver of Buy America Domestic Content Requirements for Rolling Stock Procurement in Limited Circumstances

Notice of final policy and public interest waiver. Published 09/01/16, Effective 09/01/16

Summary: This final policy consists of the Federal Transit Administration's (FTA) policy statement regarding its implementation of the phased-in increase in domestic content for rolling stock under the FTA's Buy America statute, as amended by the Fixing America's Surface Transportation (FAST) Act. Through this final policy, FTA is providing guidance to transit agencies and transit vehicle manufacturers regarding how they are to implement the FAST Act's statutory amendments. Additionally, FTA is providing notice of public interest waivers of Buy America domestic content requirements for rolling stock procurements in limited circumstances. (content more than 60 percent for FY2016 and FY2017, more than 65 percent for FY2018 and FY2019, more than 70 percent for FY2020 and beyond)

Buy America FAST ACT Fact Sheet: https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/Buy_America_Fact_Sheet.pdf

Transit Asset Management; National Transit Database; Final Rule Published 07/26/16, Effective 10/01/16

Summary: The Federal Transit Administration is publishing a final rule to define the term state of good repair and to establish minimum Federal requirements for transit asset management that will apply to all recipients and sub-recipients of chapter 53 funds that own, operate, or manage public transportation capital assets. This final rule requires public transportation providers to develop and implement out transit asset management (TAM) plans. TAM plans must include an asset inventory, condition assessments of inventoried assets, and a prioritized list of investments to improve the state of good repair of their capital assets. This final rule also establishes state good repair standards and four state of good repair (SGR) performance measures. Transit providers are required to set performance targets for their capital assets based on the SGR measures and report their targets, as well as information related to the condition of their capital assets, to the National Transit Database.

Public Transportation Safety Program; Final Rule Published 08/11/16, Effective 09/12/16

Summary: The Federal Transit Administration is issuing a final rule to establish substantive and procedural rules for FTA's administration of a comprehensive safety program to improve the safety of the Nation's public transportation systems. This

final rule provides the framework for FTA to monitor, oversee and enforce transit safety, based on the methods and principles of Safety Management Systems.

Environmental Programs; What's new:

FTA recently released its Greenhouse Gas Emissions from Transit Projects: Programmatic Assessment. The programmatic assessment serves to report on whether certain types of proposed transit projects merit detailed analysis of their GHG emissions at the project level and to provide a source of data and analysis for FTA and its grantees to reference in future environmental documents for projects in which detailed, project-level GHG analysis would provide only limited information beyond what is collected and considered in this programmatic analysis. A GHG emissions estimator tool and accompanying user guide are also available.

FTA recently updated its environmental review process standard operating procedures (SOPs) to reflect changes made by MAP-21 and the FAST Act. The SOPs are not formal guidance, but provide FTA staff with process requirements and best practices for consideration as they manage public transportation projects through the environmental review process. FTA and FHWA recently issued a final rule implementing FAST Act changes to our categorical exclusions for projects receiving limited Federal financial assistance and FHWA's process for programmatic agreements.

FTA recently updated its Guidance for Implementation of FTA's Categorical Exclusions (23 C.F.R. §771.118) to reflect inflation adjustments to the previous threshold limits of FTA's "Action with Limited Federal Funding" categorical exclusion, along with implementation changes. The inflation adjustments are discussed in the rule.

FTA and FHWA recently issued a final rule for the transportation planning process, implementing changes to that process in MAP-21 and the FAST Act, including new authority for integrating the planning and environmental review processes as well as programmatic mitigation plans.

https://www.transit.dot.gov/regulations-and-guidance/environmental-programs/environmental-programs

The VW Consent Decree Zero Emission Vehicle Investment (EPA)

On October 25, 2016, the court approved a settlement partially resolving allegations that Volkswagen violated the Clean Air Act (CAA) by the sale of approximately 500,000 model year 2009 to 2015 motor vehicles containing 2.0 liter diesel engines equipped with "defeat devices." As part of this settlement, Volkswagen is required to invest $2 billion to advance zero emission vehicles (ZEVs) and ZEV infrastructure. The partial settlement and the provisions about the ZEV Investment are largely found in paragraph 13 of the CD and Appendix C and Appendix C-1 to the consent decree (CD).
The document at the following link contains frequently asked questions about the $2 billion ZEV investment that Volkswagen is required to make. EPA will update this document as necessary.
https://www.epa.gov/sites/production/files/2016-11/documents/vw-faqs-app-c-final-11-18-16.pdf

VOLKSWAGEN SETTLEMENT FUNDING: WHAT CITIES SHOULD KNOW
(Center for Climate and Energy Solutions)

In October 2016, the U.S. government granted final approval of a $14.7 billion settlement against Volkswagen (VW) for equipping more than 500,000 of its diesel vehicles to cheat U.S. vehicle emissions tests in violation of the Clean Air Act. Volkswagen will spend $10 billion on vehicle buybacks and $4.7 billion to mitigate the pollution from these cars and invest in green vehicle technology. This latter amount will be split between two investment programs that states, cities, and tribes can use to expand alternative fuel vehicle projects and access to zero emission vehicles (ZEVs). Cities can play a key role, starting now, by identifying local emissions-cutting and zero-emission vehicle deployment projects that could benefit from increased investment and proposing ideas to states and Volkswagen about ways these funds can best be leveraged.

https://www.c2es.org/docUploads/vw-settlement-final.pdf

14 Other Resources

Fleet DNA: NREL provides an on-line tool that uses duty cycle data from transit buses to help optimize the design of advanced vehicle technologies, or for selecting a specific technology. There are several tools available on this site including one that allows a fleet to calculate their petroleum use, cost of ownership, and GHG emissions. The *Fleet DNA Project Data Summary Report* provides a graphic summary of the city transit bus duty cycle data.