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Federal Best Practices: Core Principles of Sustainable Fleet Management

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FEMP Federal Energy Management Program

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Executive Summary

This document is designed to help agency fleet managers understand and implement optimal petroleum reduction strategies for each fleet location by evaluating the most appropriate combination of the four core principles of sustainable fleet management:

- **Right-sizing the fleet** to agency mission by implementing a vehicle allocation methodology study
- **Minimizing vehicle miles traveled**
- **Increasing fleet fuel efficiency** by replacing inefficient vehicles with more fuel-efficient vehicles, maintaining vehicles, driving more efficiently, and avoiding excessive idling
- **Optimizing cost-effective alternative fuel use**, including maximizing use of existing alternative fuel infrastructure, installing alternative fuel infrastructure where practical (including electric vehicle charging stations), and aligning deployment of alternative fuel vehicles with fueling infrastructure.

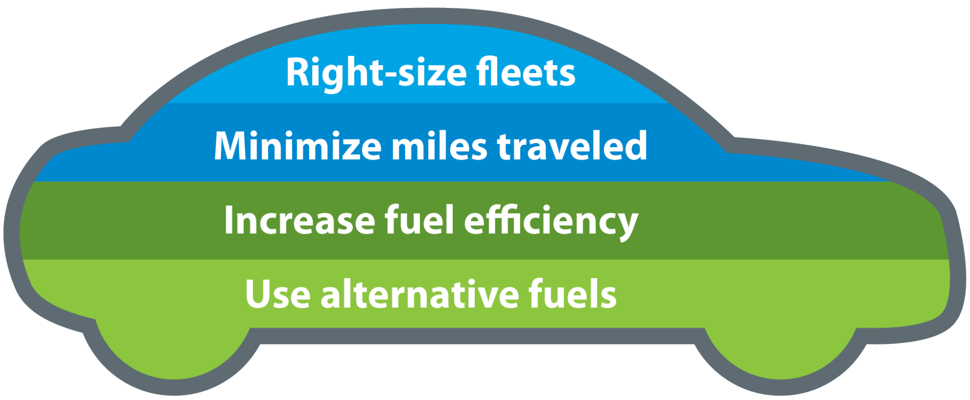

Figure ES-1. Core principles of sustainable fleet management

Image credit: National Renewable Energy Laboratory

List of Acronyms and Abbreviations

AFDC	Alternative Fuels Data Center
AFV	alternative fuel vehicle
BEV	battery electric vehicle
B100	neat (100%) biodiesel
CAA	Clean Air Act
CH_4	methane
CNG	compressed natural gas
CO_2	carbon dioxide
DOE	U.S. Department of Energy
E10	fuel blend of 10% ethanol and 90% gasoline
E15	fuel blend of 15% ethanol and 85% gasoline
E85	fuel blend of 85% ethanol and 15% gasoline
ECRA	Energy Conservation Reauthorization Act
EISA	Energy Independence and Security Act
EPA	Environmental Protection Agency
EPAct	Energy Policy Act
EV	electric vehicle
EVSE	electric vehicle supply equipment
FAST	Federal Automotive Statistical Tool
FCEV	fuel cell electric vehicle
FEMP	Federal Energy Management Program
FFV	flex -fuel vehicle
FleetDASH	Fleet Sustainability Dashboard
FMIS	Fleet Management Information System
FMP	fleet management plan
FMR	Federal Management Regulation
FMVRS	Federal Motor Vehicle Registration System
FY	fiscal year
GGE	gasoline gallon equivalent
GHG	greenhouse gas
GPS	global positioning system
GSA	U.S. General Services Administration
H_2	hydrogen
HDV	heavy-duty vehicle
HEV	hybrid electric vehicle
LDV	light-duty vehicle
LE	law enforcement
LNG	liquefied natural gas
LPG	liquid petroleum gas

LSEV	low-speed electric vehicle
MDPV	medium-duty passenger vehicle
MDV	medium-duty vehicle
mpg	miles per gallon
MY	model year
NDAA	National Defense Authorization Act
NEV	neighborhood electric vehicle
NHTSA	National Highway Traffic Safety Administration
PHEV	plug-in hybrid electric vehicle
psi	pounds per square inch
R100	neat (100%) renewable diesel
SUV	sport utility vehicle
TOD	transportation on demand
U.S.C.	United States Code
VAM	vehicle allocation methodology
VIN	vehicle identification number
VMT	vehicle miles travelled

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1 Introduction

Agencies can meet their mission-critical needs and comply with all Federal fleet sustainability goals and mandates by reducing fleet petroleum consumption through the appropriate combination of the four core principles of sustainable fleet management:

1. Right-sizing fleets and vehicles to match mission needs
2. Reducing vehicle miles travelled (VMT) and idling
3. Increasing fleet fuel efficiency
4. Increasing use of alternative fuels (including biodiesel blends) and electricity (through deployment of plug-in electric vehicles [EVs] and related charging infrastructure).

Sections 2 through 5 of this document provide greater detail on the core principles to help each Federal agency fleet manager develop a strategic plan for their fleet. Each manager should evaluate petroleum reduction strategies and tactics for his or her fleet location based on an evaluation of site-specific characteristics, including availability of alternative fuel, fleet size, and fleet vehicle composition.

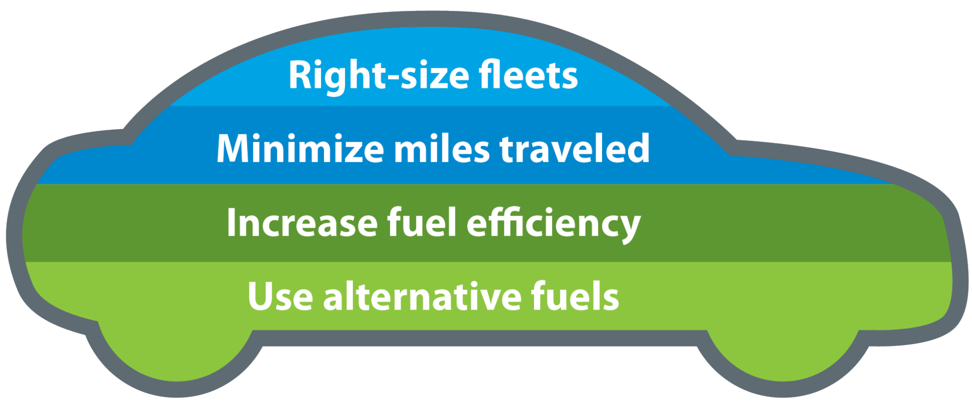

Figure 1. Summary of Federal fleet requirements

Image credit: National Renewable Energy Laboratory

1.1 Principle I—Right-Size Fleets and Vehicles to Mission

Right-sizing involves matching an agency's vehicle needs to its mission requirements. Agencies can use right-sizing to identify and eliminate inefficient vehicles and replace them, if necessary, with vehicles that use less petroleum per mile (i.e., more fuel-efficient vehicles) and use alternative fuels where available. Right-sizing helps an agency determine the optimum fleet inventory at each fleet location that will support the overall agency fleet petroleum reduction strategy. Using this principle will help agency fleet managers identify opportunities to eliminate unnecessary vehicles, deploy more efficient vehicles, reduce fuel usage and miles driven, and promote the deployment and use of alternative fuel vehicles (AFVs). Additionally, the analysis of fleet operations for right-sizing should help agencies identify opportunities to promote the cost-effective operation and maintenance of the fleet throughout the life cycle of fleet vehicles, by minimizing vehicle acquisition, fuel, maintenance, and other operational costs.

1.2 Principle II—Reduce Vehicle Miles Travelled

Agency fleets can reduce their fuel consumption by implementing tactics to reduce VMT and avoid unnecessary travel, including:

- **Eliminating vehicle trips.** Using telephone, video, and web conferencing tools for meetings, work from home when practical, and walk or bike as appropriate.
- **Consolidating trips.** Consolidating routes and carpooling to eliminate duplication of trips.
- **Providing agency shuttles.** Providing a shuttle service for high-use routes to consolidate trips.
- **Using mass transportation.** Using mass transportation alternatives to eliminate fleet vehicle transportation needs.
- **Improving scheduling and routing.** Optimizing travel time and distance for delivery of services by using telematics and global positioning system (GPS) technology to improve routing and efficiency of fleet vehicles.
- **Implement transportation on demand (TOD).** Using demand-responsive systems to offer shuttle, bus, car sharing, or carpooling service to employees.

1.3 Principle III—Increase Fleet Fuel Efficiency

Fleet managers can increase fleet fuel efficiency by:

- **Acquiring fuel-efficient vehicles.** Agencies should deploy the smallest, most fuel-efficient vehicles appropriate for each vehicle's mission.
- **Acquiring hybrid electric vehicles (HEVs).** HEVs often top their vehicle classes in fuel economy without requiring new alternative fueling infrastructure.
- **Maintaining vehicles to improve fuel economy.** Agencies should implement best practices such as maintaining recommended tire pressure and performing scheduled maintenance to keep vehicles in proper working order.
- **Driving more efficiently.** Drivers of fleet vehicles should drive sensibly, observe the speed limit, remove excess weight from the vehicle, use cruise control, and map more efficient, fuel-saving routes.
- **Avoiding excessive idling.** Agencies should implement best practices such as turning off engines when vehicles are idle or stationary to eliminate unneeded fuel use, and install idling mitigation systems to power the vehicle's onboard systems or equipment without using the engine.

Fleet managers should also note that they can attain the largest fleet fuel efficiency gains and petroleum reductions by applying the measures above to increase the fuel efficiency of their least-efficient vehicles (e.g., medium-duty vehicles [MDVs] and heavy-duty vehicles [HDVs]).

1.4 Principle IV—Optimize Cost-Effective Alternative Fuel Use

This principle focuses on maximizing the displacement of petroleum with alternative fuels. Alternative fuels include (but are not limited to): electricity, E85 (a fuel blend of up to 85% ethanol and at least 15% gasoline), neat (100%) biodiesel (B100),[1] neat (100%) renewable diesel (R100), hydrogen (H_2), compressed natural gas (CNG), liquefied natural gas (LNG), and liquid petroleum gas (LPG). Agencies should consider using

[1] The definition of alternative fuels (42 U.S.C. 13211(2), Section 301(2) of EPAct 1992) includes B100 but not biodiesel blends. However, agencies may count the pure biodiesel component of biodiesel blends greater than 20% (B20 or greater) toward the target for fleet alternative fuel use.

alternative fuels whenever possible and should decide on the type of AFV and related infrastructure based on the fleet location characteristics:

- **EVs, including battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs), and their charging infrastructure** are suitable for most fleet locations, especially those without access to other alternative fuels.
- **AFVs that use E85, CNG, hydrogen, and other alternative fuels that require dedicated infrastructure** should be placed at fleet locations where alternative fuel is available or at high-use locations where alternative fuel sites are planned in the near-term. In order to promote increased alternative fuel consumption by AFVs in the Federal fleet, Section 701 of the Energy Policy Act (EPAct) of 2005 requires Federal agencies to use alternative fuel in its dual-fueled AFVs, except where the vehicles have received a waiver from the U.S. Department of Energy (DOE) due to the local unavailability of alternative fuel or fuel that is unreasonably more expensive than gasoline. This means, for example, that if E85 infrastructure is available at or near a fleet location, fleet E85 flex-fuel vehicles (FFVs) operating at that location are required to refuel solely with E85 using that infrastructure.
- **Biodiesel blends, which require dedicated infrastructure but can be used in conventional diesel vehicles**, are ideal for locations with high diesel fuel use.

To maximize petroleum reduction, agencies should support strategies to increase alternative fuel use by:

- **Acquiring AFVs**, including BEVs and PHEVs, and placing them in or near areas with existing or planned alternative refueling sites (agencies should ensure alternative fuel infrastructure, including charging infrastructure and the associated fuel necessary to support dedicated AFVs, is in place before accepting delivery of vehicles), and by running dual-fueled AFVs on alternative fuel.
- **Installing alternative fuel infrastructure (including charging infrastructure)** at fleet locations with the highest concentrations of AFVs that use that fuel type.
- **Communicating and coordinating with nearby fleets** (both public and private sector) to aggregate demand for alternative fuel.

2 Right-Sizing Fleets and Vehicles to Mission with a Vehicle Allocation Methodology

Agencies should right-size fleets to identify and eliminate unnecessary and/or inefficient vehicles and replace them, if necessary, with more efficient vehicles and AFVs. To right-size its fleet, an agency must (1) compile its vehicle inventory and understand how its vehicles are used (e.g., mileage, purpose); and (2) analyze the fleets' operational (or mission) needs, while identifying opportunities to eliminate unnecessary, inefficient, and/or nonessential vehicles from the agency's fleet inventory.

Right-Sizing Fleets

Right-sizing means matching an agency's vehicle needs to its mission requirements.

What Is an Optimal Fleet?

An optimal fleet consists of the fewest and most cost-efficient vehicles necessary to complete an agency's mission and comply with all statutory requirements.

A structured vehicle allocation methodology (VAM) process provides a framework for right-sizing an agency's fleet. The U.S. General Services Administration's (GSA's) Federal Management Regulation (FMR) § 102-34.50 requires that each federal agency establish and document a structured VAM to determine the appropriate size and number of motor vehicles in the fleet and identify opportunities to eliminate unnecessary vehicles, right-size vehicles for their missions, and deploy AFVs effectively. GSA suggests that each agency complete a VAM at least once every 5 years; agencies should conduct VAM studies more frequently if missions or resources change. A VAM study can help your agency determine its optimal fleet inventory and reduce fleet costs. It can also support a fleet management plan (FMP) through the appropriate acquisition, placement, and use of higher-efficiency vehicles and AFVs. This plan should include an optimal fleet inventory size projection (by vehicle class and fuel type) to meet mission needs and sustainability requirements.

2.1 Characteristics of a Vehicle Allocation Methodology

GSA FMR Bulletin B-43 provides guidance to assist agencies in establishing and documenting a structured VAM. Objective characteristics—the metrics used to justify a vehicle in the fleet—may be identical across an agency's fleet, may differ from bureau to bureau, or may differ from location to location within an agency. Development of a VAM provides agency fleet managers with a standard way to document the objective characteristics of a vehicle fleet for (1) a specific bureau or department and/or (2) a generic (where there are common characteristics) office/facility, program, occupational group, or other entity within an agency.

Objective characteristics should include, but are not limited to:

- Number of vehicle users at a given site
- User-to-vehicle ratios (where applicable)
- Per-vehicle mileage (historical and expected)
- Hours of use and trips per vehicle
- Vehicle mission criticality
- Terrain and climate
- Fleet condition and down time.

Vehicle Allocation Methodology

Section 102-34.50 of the GSA FMR requires all Federal executive agencies operating domestic or foreign fleets to establish and document a structured VAM to determine the appropriate size and number of motor vehicles (i.e., optimize fleets to agency mission).

The data for the VAM are typically obtained by surveys and/or in-person interviews of stakeholders. However, much of these data could be collected and maintained while an agency is collecting vehicle inventory data for its annual data submission requirements.

2.2 Overview of the Vehicle Allocation Methodology Process

Typically, the first step in conducting a VAM is completing a detailed vehicle utilization study to establish a baseline fleet profile. Agency headquarters fleet managers and agency fleet location managers can use the results of the baseline fleet profile to create a list of vehicles approved to meet mission needs for each organization. GSA Fleet can help your agency throughout this process and should be consulted when assessing the need for GSA-leased vehicles. Table 1 outlines the general VAM process, and the sections that follow detail each step.

Table 1. General Vehicle Allocation Methodology Process

Step	Summary	Actions	Purpose
1	Create baseline fleet profile	• Identify agency mission tasks and vehicle assets assigned to those tasks • Complete an annual review of each fleet vehicle and collect data on utilization, down-time, age, maintenance, acquisition cost, number of users, per-vehicle mileage, trips per vehicle, mission, terrain, climate, fleet condition, number of passengers, and cargo capacity	Perform a fleet utilization study to identify current vehicle assets and how well they match with agency mission needs
2	Develop minimum vehicle utilization criteria	• Determine vehicle assets required to complete necessary mission tasks • Identify any critical missions that require vehicle retention no matter the utilization • Establish minimum utilization criteria to validate the need for vehicles based on their missions, such as mileage requirements, hours used, use (daily percentage), passengers carried, number of trips, and user/vehicle ratio	Establish a baseline of fleet assets required to complete necessary mission tasks
3	Compare existing fleet composition to mission task needs	• Determine if vehicles meet minimum criteria needed to accomplish mission tasks • Evaluate alternatives, including mass transportation or contract shuttle services • Determine vehicles that are mission essential • Identify vehicles below minimum utilization or mileage requirements and dispose or reassign as needed	Complete gap analysis of current vehicle assets and mission needs and eliminate or replace vehicles that do not meet mission needs
4	Develop a vehicle acquisition plan to support VAM results	• Create a 5-year vehicle acquisition and replacement plan, with recommended vehicles (type and size) for each mission as determined by the VAM • Create a list of vehicles approved for each organization that meets the agency mission	Establish clearly defined policy to ensure that the fleet and vehicles are correctly sized and appropriate for the agency mission
5	Review and update VAM	• Complete an FMP, which includes the agency strategy to achieve their optimal fleet inventory and annual progress toward achieving that inventory • Review and update the agency VAM annually or sooner as agency mission needs change	Revise VAM based on changes in vehicle solutions or agency mission needs

2.3 Creating a Baseline Fleet Profile

Before selecting petroleum reduction strategies, agency headquarters fleet managers should work with their respective regional and local fleet managers to create a baseline fleet profile. Typically, the first step in developing a fleet profile begins with gathering fleet data managed in an agency's fleet management information system (FMIS). Some data may also be available in GSA's Federal Motor Vehicle Registration System (FMVRS) and in the Federal Automotive Statistical Tool (FAST). Once the data are collected, the agency can begin conducting a detailed fleet utilization study, which entails identifying agency mission tasks and vehicle assets assigned to those tasks.

A complete utilization study should include a review of each fleet vehicle and collection of annual data on:

- Vehicle identification number (VIN) or serial number
- License plate number
- Vehicle make and model
- Model year
- Vehicle type and weight class
- Acquisition cost
- Vehicle ownership
- Utilization
- Periodic (weekly, monthly, or annual) miles per vehicle
- Periodic hours of use per vehicle
- Periodic number of trips per vehicle
- Maximum miles per trip
- Lifetime mileage
- Vehicle in-service date
- Fuel type
- Fuel use by type
- Fuel economy rating
- Greenhouse gas (GHG) emission rating
- Energy Independence and Security Act (EISA) Section 141 compliance
- Vehicle function
- Fleet mission
- Required employee response times
- Number of users
- Ratio of employees to vehicles
- Periodic (weekly, monthly, or annual) down-time
- Maintenance
- Vehicle condition
- When vehicle is scheduled for replacement
- Suitability for replacement with different vehicle type or fuel type
- Needed passenger and cargo capacity
- Installed aftermarket equipment
- Vehicle's garage location by address and latitude/longitude (at least to fourth decimal)
- Frequency vehicle is parked overnight away from garage location
- Whether vehicle is shared with other organizations
- Terrain
- Climate.

Fleets may collect this information through user surveys. Typical questions include:

- What tasks do you accomplish with the vehicle? Describe how those tasks support the agency's mission.
- Does the vehicle need special equipment (aftermarket equipment not standard to commercial vehicles and trucks) to accomplish the tasks?
- How important is the vehicle to accomplishing the mission? Describe the critical mission need.
- How many people will be transported per trip on a regular basis?
- How much and what type of cargo will the vehicle haul on a regular basis?
- Is the vehicle shared with other employees or other agency organizations?
- Is there access to alternative fuel within 3 miles of the vehicle's operating location? If so, where is the fueling station located and what type of alternative fuel is available?
- If the vehicle is a dual-fueled AFV, does it use alternative fuel most of the time or does it have an approved waiver from the use of alternative fuel?
- In what type of driving conditions will the vehicle operate (exclusively on campus setting, city, highway, off road, weather, etc.)?
- Can the work be done via alternatives to owning or leasing a vehicle such as shuttle bus services, motor pool vehicles, sharing vehicles with other offices/agencies, public transportation, or short-term rentals when needed?

Next, the agency fleet manager should compile the detailed fleet utilization study data to document a full description of an agency's fleet composition together with its unique mission requirements. This profile, preferably managed in a database, provides a snapshot of each vehicle asset in the fleet. Typical data includes everything captured in the questionnaire as described above.

The ultimate goals of this profile are: (1) to assist the fleet manager in evaluating whether the characteristics and utilization of each vehicle are best aligned with the agency mission needs; and (2) to determine opportunities for optimizing the utilization of each vehicle, including replacement, acquisition, or disposal, based on mission needs.

The basic framework for this fleet profile should identify the following components on a site-by-site basis that are consistent with average vehicle utilization: **mission requirements, the right-size vehicles for the tasks at hand, and fuel use needs.** Vehicle utilization rates change regularly, and fleet profiles should be updated on an ongoing basis to reflect changes in mission needs and the regulatory climate, as well as vehicle and fuel availability.

2.4 Developing Minimum Vehicle Utilization Criteria

Quality data collection and management are critical to effective fleet management, and the process to establish vehicle utilization criteria is no different. The objective of this step is to determine the minimum vehicle requirements required to complete each mission task. These requirements, or minimum vehicle utilization criteria, may be expressed in per-vehicle mileage, hours in service, user/vehicle ratios, trips per vehicle, utilization (daily percent), and/or passengers carried.

Vehicle utilization is most easily measured in terms of mileage or hours in service, although which utilization criteria you choose will depend on your agency's fleet needs.

- **Mileage is most typically used to measure use of passenger or cargo transportation vehicles where the vehicle's primary purpose involves travel**. Mileage can be collected manually from the odometer or automatically through on-board vehicle monitoring systems or telematics. Odometer readings can be included with the driver's report (if used), telematics dashboards, input when refueling, or collected as a separate task. Mileage data should be collected at regular intervals over a long period of time to be most effective in determining vehicle utilization. The collection of mileage data over time should also allow agencies to identify slower and busier periods of usage as well as time needed for maintenance and repairs. For passenger or cargo transportation vehicles, it may also be useful to collect data on the number of passengers or volume of cargo transported.

- **Hours in service is a typical measure of vehicle use for tradesmen, utility repair, or emergency response** where the vehicle supports a mission while remaining mostly stationary (such as for plumbers, electricians, high-voltage linemen, and fire fighters). Utilization should be measured by the hours the vehicle is in service supporting the mission, which can be determined from the driver's labor reports (where used), dispatch records, and automatically from on-board vehicle monitoring systems. Utilization of fire apparatus and other vehicles that stand by waiting for an emergency response are in service whenever they are available for use. For example, a plumber's vehicle is in service from the time the plumber leaves the shop to perform mission work until the plumber returns to the shop, while a fire truck in a fire station is in service whenever it is manned and ready for dispatch. Spare vehicles are not in service. **A telematics geofence around a motor pool can identify the minimum number of spare vehicles in the pool at any given time.**

Once an accurate measure of vehicle use has been made for all vehicles in the fleet, vehicles with similar missions should be compared and an average utilization calculated. Vehicles falling far below average should be examined to determine the reason(s) for underutilization. In time, the lowest acceptable utilization rate for vehicles completing a particular mission will become apparent, but even this baseline should be continuously reviewed and steps should be taken to move the utilization rate higher. **Vehicles with the lowest average utilization rate should be considered for disposal as appropriate.** Short-term leases and rentals, while more expensive up front than other options, may be cost-effective replacements for vehicles needed only during certain portions of the year. In 2011, GSA amended FMR § 102-34.35 to enable agencies to rent vehicles for up to 120 consecutive days (originally 60 consecutive days). This policy enables agencies to consider replacing underutilized vehicles in their inventory by renting vehicles for seasonal and temporary usage.

Other utilization metrics may include:

- Vehicle down time
- Hours spent on call or stand-by ready to go
- Whether the vehicle can achieve required mission response times
- Vehicle age and/or condition
- Number of trips per day, week, or month.

2.5 Comparing Existing Fleet Composition to Mission Task Needs

Once an agency has completed a utilization study, created a baseline fleet profile, and established minimum vehicle utilization criteria, it should compare its existing fleet composition to its mission task needs. The purpose of this step in the VAM process is to determine which vehicles in the current fleet are well suited to their current assignment—and which ones are not—as a precursor to the vehicle acquisition, disposal, and reassignment process. Some of the questions that should be asked during this process include:

- Is the vehicle mission critical or essential?
- Does the vehicle meet the minimum requirements needed to accomplish mission tasks?
- Can an existing asset fulfill new mission requirements?
- Is the vehicle utilization below the minimum baseline?
- Can an alternative form of transportation such as mass transportation, shuttle services, or car sharing be used instead?
- What vehicles can be disposed of or reassigned (work with GSA Fleet for GSA-leased vehicles)?

Each fleet manager's challenge is to determine the correct vehicle for each mission. The following information may be helpful in this process:

- **Employee transportation.** Vehicles used to transport a single person should be the smallest possible size sedan. Pickup trucks and sport utility vehicles (SUVs) are not the most cost-effective means to transport a single passenger but might be needed for rough terrain. Agencies should also consider the use of public transportation or the consolidation of transportation options with other agencies, such as car sharing or shuttles, to form a single cost-saving solution.
- **Cargo vehicles.** The transportation of cargo should also use the smallest possible vehicle to accomplish the mission, especially where the existing vehicle is never operated at full capacity. Acquiring a single larger vehicle when it could replace several smaller vehicles may also increase vehicle efficiency.
- **Seasonal vehicles.** For vehicles used seasonally (e.g., snow removal equipment, brush-fire-fighting vehicles) and for vehicles with a single purpose that is not also a regular need (e.g., trucks with a mounted crane, water distributors, equipment transporters), the use of multipurpose vehicles, vehicles equipped with quick change bodies, short-term leased vehicles, vehicles used jointly by more than one agency—or even contracting out the service—could provide savings while still meeting mission needs.
- **Spare vehicles.** Some of the most expensive, least fuel-efficient, and most unsuitable vehicles for the mission can be "free" vehicles picked up as surplus and maintained as "spares." However, spare vehicles significantly increase maintenance costs, redirecting maintenance that should be invested in first-line vehicles, and often do not perform well when needed. A well-maintained fleet will have few requirements for spares that cannot be met through redistribution of existing assets or a short-term rental. Fleets with more than a couple spares should be avoided.
- **Law enforcement and emergency response vehicles.** Though agencies may exempt these vehicles from Federal fleet requirements, agencies should make every effort to ensure that the most efficient vehicles are used to meet their law enforcement (LE) and emergency response needs. Perhaps the easiest way to improve the efficiency of these vehicles without compromising their mission is to replace older vehicles with newer vehicles, which tend to be more efficient.
- **Vehicle assignment.** Drivers often have vacation, sick days, and other days off the job, meaning that many vehicles assigned to a single driver will sit idle for one month or more per year. Avoiding the assignment of a single driver to a vehicle whenever possible will improve fleet vehicle utilization, reduce costs, and

Vehicle Pools

Maximize vehicle utilization by pooling vehicles or assigning multiple drivers per vehicle where possible.

decrease vehicle requirements. Pooling vehicles or using assigned vehicles for other uses when the driver is absent will increase utilization and reduce the total number of vehicles needed to accomplish the same mission. Effective vehicle pooling can be accomplished using dispatching/reservation software or a car sharing service provider.

At the completion of this analysis, the agency will be able to determine the optimal fleet inventory that meets the agency mission task needs. The agency should:

- Create **a list of vehicle types approved for each organization and mission requirement** (vehicles selected should be the most efficient possible)
- Identify **vehicles that are essential to the mission**, regardless of utilization (determine the most efficient vehicle type to provide that mission)
- Identify all **vehicles that fall below the pre-established minimum utilization criteria** and plan for the disposal or reassignment of those vehicles as necessary
- Evaluate **transportation alternatives**, such as public transportation, contract shuttle services, car sharing services (reserving a vehicle for short term use), ridesharing services (requesting individual transportation services), or rental vehicles.

2.6 Developing a Vehicle Acquisition Plan to Support the Vehicle Allocation Methodology

The purpose of the VAM process is to develop a standardized methodology by which an agency's fleet is evaluated each year. As a result, agencies should establish clearly defined policies and procedures to ensure that the entire fleet is correctly sized and each vehicle is appropriately assigned based on mission needs. This may include creating a list of vehicles that are approved for each organization within an agency and are critical to meeting that organization's mission. **At the end of the VAM process, agencies should create a 5-year vehicle acquisition and replacement plan with recommended vehicles (type and size) for each mission as determined by the VAM.** This plan should be clearly communicated through all levels of the agency and address the following items:

- The agency's planned **schedule** to achieve its optimal inventory
- Plans for **locating AFVs near alternative fueling stations**
- **Vehicle sourcing decisions**, including comparing costs for purchasing vehicles rather than leasing vehicles through GSA Fleet or commercially.

Actual fleet inventory results are compared to and measured against the agency's optimal fleet inventory each year. Agencies should create an FMP describing the agency's strategy to achieve their optimal fleet inventory and the progress toward achieving that inventory. Discrepancies should be noted, including a discussion of factors that may be hindering attainment of your optimal fleet.

2.7 Optimizing Fleets and Vehicles to the Agency Mission

A recurring objective of Federal fleet management is to align (or optimize) the composition of an agency's fleet with its mission. This means more than simply right-sizing a fleet/vehicle or selecting a set of petroleum reduction strategies. In the planning phase of the fleet management cycle, agencies should have developed a clear set of goals and objectives for the management of their fleets.

The goal for agencies in optimizing their fleets is to ensure every vehicle (1) is as fuel efficient and cost-effective as possible, (2) meets the mission to which it is assigned, and (3) allows the agency to meet statutory requirements and achieve its overarching fleet management goals. Evolving missions, vehicle funding shortfalls, and better automotive technology make this an ever-changing target, which means that every possible cost- and fuel-saving solution must remain on the table for consideration whenever that solution could meet actual mission needs. The challenge for each fleet manager is to regularly compare the existing fleet to the optimal fleet and ensure that the agency is working to acquire and use the most efficient vehicles that match the agency's mission needs and comply with all statutory requirements.

3 Reducing Vehicle Miles Travelled

One of the first steps in developing an agency-wide petroleum reduction strategy is to evaluate opportunities to reduce the miles your fleet travels. Reducing fleet VMT decreases fleet petroleum use and fleet costs, including reduced vehicle operational and maintenance costs and lower vehicle capital costs resulting from longer vehicle life before replacement. Further, reducing VMT can enable a reduction in the number (and associated cost) of vehicles required to accomplish the fleet's mission, and therefore is directly related to actions taken to right-size fleets. Fleet managers should always try to minimize VMT even while increasing fleet efficiency and alternative fuel use (including electricity).

There are no specific mandates to reduce VMT. However, success in doing so contributes to achieving EISA Section 142 petroleum reduction requirements.[2] The significant benefit of this approach, relative to other petroleum reduction strategies, is the opportunity for immediate and sustained reduction of total fleet management costs.

The strategies to reduce VMT discussed in this chapter should be applied to all fleet vehicles, regardless of vehicle type (light-duty, medium-duty, or heavy-duty) or vehicle fuel type (AFV, EV, or conventional-fueled vehicle). A variety of options for VMT reduction are available for consideration and implementation. Fleet managers can implement some of these measures independently while collaboration with facility or agency management may be necessary in other cases. Measures to reduce VMT include the following:

- **Eliminating vehicle trips.** Use telephone, video, and web conferencing tools for meetings, work from home when practical, and walk or bike as appropriate.
- **Consolidating trips.** Consolidate routes and carpool to eliminate duplication of trips.
- **Providing agency shuttles.** Provide a shuttle service for high-use routes to consolidate trips.
- **Using mass transportation.** Use mass transportation alternatives to eliminate fleet vehicle transportation needs.
- **Improving scheduling and routing**. Optimize travel time and distance for delivery of services by using telematics and/or GPS technology to improve routing and efficiency of fleet vehicles.
- **Implement transportation on demand.** Use demand-responsive systems to offer shuttle, bus, or carpooling service to employees.

3.1 Eliminating Trips

Fleet managers may need to collaborate with individual employees, agency leadership, or facility management to eliminate trips. In many cases, employees determine whether to teleconference to meetings, work from home, or walk to a nearby meeting instead of driving. However, agency leadership may be able to promote that behavior. Technologies such as web conferencing allows personnel to participate in meetings remotely while sharing information as if they were present in person. Similarly, telecommuting has become more popular as more employees can perform their work at any location where they have a computer and a telephone. Finally, agencies can eliminate using a vehicle for a trip by walking and biking. Designating a safe place for bicycles or identifying safe pathways for walking enables employees to travel without using motorized vehicles.

[2] EISA Section 142 (42 U.S.C. § 6374e(a)(2)) requires Federal fleets to reduce annual petroleum consumption by a total of 20% relative to an FY 2005 baseline by FY 2015 and for each year thereafter.

3.2 Consolidating Trips

Fleet managers can reduce trips and associated VMT by consolidating trips. This may be accomplished by either (1) combining multiple operations into a single trip and/or (2) carpooling.

Fleet managers can combine trips by identifying regular or occasional trips that involve similar routes. They may accomplish this by evaluating trip scheduling and by seeking fleet operators' input and collaboration. Fleet managers and operators should determine if trips on multiple days or times can be consolidated into a single day or time.

Carpooling is similar to combining trips, but instead of evaluating similar routes, fleet managers and operators should evaluate opportunities for staff with similar destinations and schedules to share fleet vehicles and combine their individual trips into a single vehicle trip. Individual fleets may promote carpooling through formalized ride share boards (physical or virtual) or through informal networking. Trip consolidation and scheduling can significantly decrease the number of trips and associated fuel consumption.

3.3 Providing Agency Shuttles

When agencies have multiple locations or buildings within relatively close proximity to one another and a high demand for trips, agency shuttles can be an effective and efficient way to reduce VMT and fuel consumption.

GSA's FMR Bulletin B-28 provides guidance to agencies regarding Federal shuttle policies, shuttle routes supported by multiple Federal agencies, and use of AFVs in Federal shuttle bus fleets. Pursuant to the bulletin, Federal agencies should use AFVs for shuttle services whenever possible. They should also monitor shuttle utilization, survey employees, and coordinate with other Federal agencies to share and otherwise avoid duplication of shuttle services.

The DOE Federal Energy Management Program (FEMP) maintains a map of Federal shuttles in and around Washington, DC (Figure 2).[3] The shuttle map can be filtered by routes that are available to all Federal employees, including by specific agency and route. It can be used by agencies when determining whether a shuttle is necessary in this area or by employees looking for shuttles. Users can click on the routes to view timetables and information about shuttle stops.

[3] Available at www.energy.gov/eere/femp/federal-fleet-shuttle-stops-around-washington-dc.

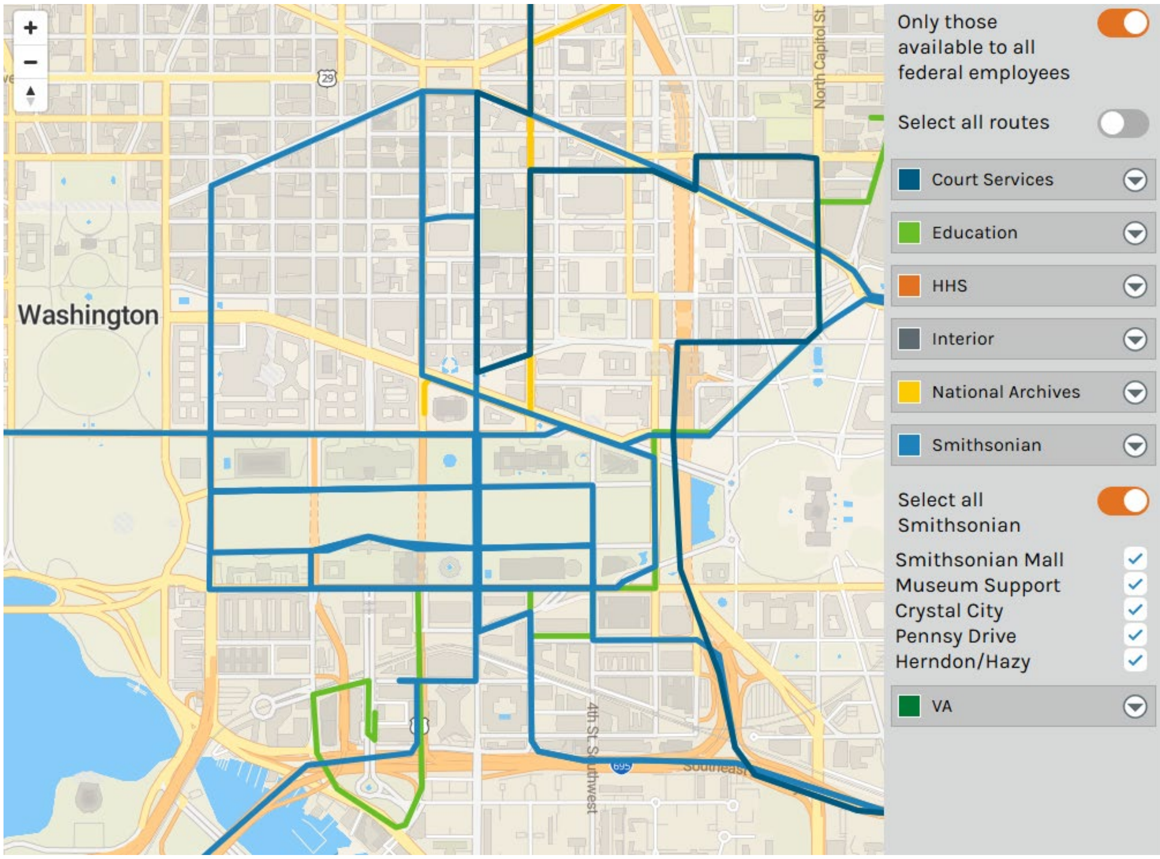

Figure 2. Federal agency shuttle maps in Washington, D.C. area

Image credit: FEMP

3.4 Using Mass Transportation

Federal agencies should investigate the availability, suitability, and cost of public transportation before acquiring vehicles from any other source. In many urban and suburban areas, use of mass transportation is an effective method to eliminate fleet vehicle trips as well as, in most cases, reduce cost and time associated with fleet vehicle use. Agencies can encourage employee use of public transportation by subsidizing the cost of bus or subway passes, perhaps using the savings realized through eliminated fleet vehicle trips.

3.5 Improving Scheduling and Routing

Efficient fleet operation is an integral part of fleet management that can save time and taxpayer dollars. Agency fleet managers are encouraged to explore both internal and external options to track and manage vehicle usage through scheduling and optimal routing. Numerous private companies offer telematics, software, and consulting services to help government entities with route and scheduling assets. Telematics solutions can include GPS directions for the driver and geofencing to alert the fleet manager when drivers are traveling outside of their assigned routes. By monitoring driver schedules and vehicle activity, agencies can:

- Create and maintain optimized master schedules for recurring tasks
- Reduce expensive fuel costs by eliminating unnecessary travel and lost time
- Increase driver/worker productivity
- Eliminate unauthorized use of vehicles, routes, or stops

- Manage employee schedules by better anticipating departure and arrival times
- Respond to emergencies with accuracy and efficiency
- Schedule preventive maintenance during low-usage days
- Provide documentation of department activity
- Do more work with the same or fewer resources.

3.6 Implementing Transportation on Demand

TOD involves transporting passengers or goods with designated drivers at the request of the users rather than following pre-set schedules. Agencies may use TOD in a few ways. One option is to aggregate individual transportation requests and service them by shuttle or bus as needed rather than drive a loop on a set schedule. Another option is to employ a carpooling service to aggregate multiple employees into a single vehicle rather than allowing each to drive individually. TOD can also be used beyond VMT elimination to reduce the number of vehicles in an agency's fleet.

4 Increasing Fuel Efficiency

Increasing fleet fuel efficiency is a simple, low-cost, and effective method to comply with statutory mandates and reduce fleet petroleum use. This section provides an overview of the following five tactics to increase fleet fuel efficiency. Agencies should implement these strategies regardless of vehicle size or fuel type.

- **Acquiring fuel-efficient vehicles.** Agencies should deploy the smallest, most fuel-efficient vehicles appropriate for the vehicles' mission(s).
- **Acquiring HEVs.** HEVs often top their vehicle classes in fuel economy and do not require alternative fueling infrastructure (and its associated costs).
- **Maintaining vehicles to improve fuel economy.** Implement best practices such as maintaining recommended tire pressure and performing scheduled maintenance to keep vehicles in proper working order so that they run efficiently.
- **Driving more efficiently.** Drive sensibly, observe the speed limit, remove excess weight, and use cruise control.
- **Avoiding excessive idling.** Implement best practices such as turning off engines when vehicles are idle or stationary for more than a minute to eliminate unneeded fuel use, and install idling mitigation systems to power the vehicle's onboard systems or equipment without using the engine.

4.1 Acquiring Fuel Efficient Vehicles

Acquiring vehicles that burn less fuel per mile (higher fuel economy) will reduce overall fleet petroleum use to complete the same agency mission. Agency fleets will likely achieve some fuel efficiency improvements just through the normal replacement cycle for fleet vehicles, because newer vehicles on average are more efficient than older vehicles. In 2020, the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Transportation's National Highway Traffic Safety Administration (NHTSA) issued final rules updating the National Program for GHG emissions and fuel economy standards for model years (MYs) 2021 through 2026 for light-duty passenger cars, light-duty trucks, and medium-duty passenger vehicles (MDPVs).[4] In 2016, EPA and NHTSA issued vehicle and engine performance standards for MDVs and HDVs designed to improve fuel efficiency.[5] These standards apply to MY 2018 to MY 2027 for certain trailers and MY 2021 to MY 2027 for semi-trucks, large pickup trucks, vans, buses, and work trucks.

4.1.1 Selecting Higher Fuel Economy Vehicles in Fleet Replacement Plans

Fuel economy is a major component of replacement plans for fleet vehicles. When ordering vehicles, agencies should answer the following questions:

- Will a vehicle in a smaller class that gets better fuel economy get the job done?
- Is there a more fuel-efficient vehicle that will meet my needs?
- Do I have access to alternative fuels?

[4] EPA, The Safer Affordable Fuel Efficient (SAFE) Vehicles Final Rule for Model Years 2021–2026, www.epa.gov/regulations-emissions-vehicles-and-engines/safer-affordable-fuel-efficient-safe-vehicles-final-rule.

[5] EPA, Final Rule for Phase 2 Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles, www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-greenhouse-gas-emissions-and-fuel-efficiency.

Federal fleet managers should use GSA's online ordering system, AutoChoice,[6] to help choose the most fuel-efficient vehicle when ordering through GSA. AutoChoice allows users to compare vehicles by fuel economy and GHG emission scores, choose equipment and color options, and compare vehicles side by side.

The DOE and EPA Fuel Economy website[7] is another excellent interactive resource where users can compare cars and trucks based on emissions and fuel efficiency. Fleet managers can search the site's database and compare the environmental performance and fuel economy of most light-duty models and types, including cars, SUVs, pick-up trucks, and vans. To support compliance with the EISA Section 141 low GHG-emitting vehicle acquisition requirements,[8] the guide also compares vehicle emissions using both GHG scores and amount of carbon dioxide (CO_2) emitted from the vehicle's tailpipe (GHG scores are used to rate the amount of smog-producing pollutants and CO_2 emissions, respectively, on a scale of 0–10, with 10 representing the lowest-emission vehicle in each case).

Since the adoption of the national program for GHG emissions and fuel economy standards, average fuel economy for new vehicles has risen quickly. Replacing older vehicles with new vehicles, even of the same make and model, can significantly improve fuel economy. As the bar gets raised, fleet managers should continue to seek the highest efficiency vehicles that still allow them to meet their respective agency's mission needs.

4.1.2 Focusing on Increasing the Fuel Economy of the Least Efficient Vehicles

Fleets can obtain greater fuel efficiency gains by targeting their least efficient vehicles. The results can be dramatic because, as shown in Figure 3, lower fuel-economy vehicles use far more fuel than high fuel-economy vehicles for similar missions and annual mileage. Potential petroleum reductions from improving fleet vehicle fuel economy increase exponentially as the gas mileage (miles per gallon [mpg]) of the replaced vehicle decreases. Therefore, agencies should focus on opportunities to improve the fuel efficiency of the lowest fuel economy vehicles in their fleets. Small improvements in the fuel efficiency of a larger, lower fuel economy vehicle may achieve greater fuel savings than large improvements in the efficiency of a smaller, higher fuel economy vehicle.

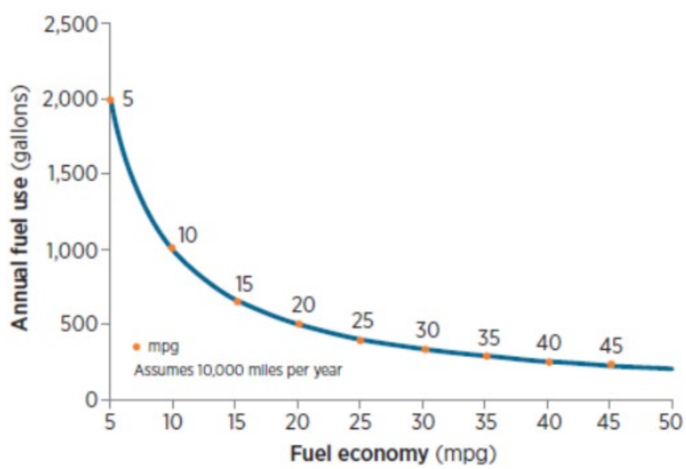

Figure 3. Annual fuel use by fuel economy

[6] Available at www.gsa.gov/autochoice.
[7] Available at www.fueleconomy.gov.
[8] EISA Section 141 (42 U.S.C. § 13212(f)(2)) prohibits Federal agencies from acquiring LDVs and MDPVs that are not low-GHG emitting vehicles, unless the vehicle qualifies for a functional needs exemption or the agency reduces emissions through alternative measures.

Table 2 provides an example that illustrates the benefits of focusing on improving the fuel efficiency of the lowest fuel-economy vehicles. This is clearly demonstrated by the four-fold increase in fuel reduction by replacing a 5-mpg vehicle with a 6.25-mpg vehicle (25% increase in fuel economy) compared to replacing an existing 20-mpg vehicle with a 25-mpg vehicle (25% increase in fuel economy).

Table 2. Example Annual Fuel Reductions from Improving Fuel Economy

Current MPG	Current Fuel Use (Gallons)	Replacement MPG	Replacement Fuel Use (gallons)	Percent Improvement in Fuel Economy	Fuel Reduction (Gallons)
5 mpg	2,000	10 mpg	1,00	**100%**	**1,000**
5 mpg	2,000	6.25 mpg	1,60	**25%**	**400**
20 mpg	500	40 mpg	250	**100%**	**250**
20 mpg	500	25 mpg	400	**25%**	**100**

4.2 Acquiring Hybrid Electric Vehicles

HEVs[9] combine the internal combustion engine of a conventional vehicle with a rechargeable energy storage system, like the battery and electric motor, of an EV. The combination can increase fuel economy while maintaining the power, range, and convenient fueling of conventional vehicles. HEV batteries are recharged by the internal combustion engine and recovery of energy ordinarily lost while braking. **They do not recharge by plugging into an external source of electricity (such vehicles are referred to as PHEVs).** While efficiency gains that HEVs achieve can contribute to petroleum reduction targets, their electricity use cannot be counted towards EISA Section 142 alternative fuel use increase requirements.[10]

4.2.1 Benefits of Hybrid Electric Vehicles

Acquiring an HEV to replace a conventional-fueled vehicle may provide a reduction of more than 30% in petroleum use, as illustrated by the example in Table 3. Efficiency gains from HEVs also depend upon the vehicle's drive cycle. Typically, HEVs are best used for drive cycles with many starts/stops, such as urban environments. Fuel reduction benefits of HEVs are typically lower when used mostly for driving on highways. In some cases, a low GHG-emitting vehicle with a standard engine may be a more cost-effective option for replacing a vehicle that primarily does highway driving.

Table 3. Estimated Fuel Economy Improvement for Hybrid Version of 2019 Chevrolet Malibu

Vehicle Model	Fuel Economy (MPG)
2019 Chevrolet Malibu Base	32
2019 Chevrolet Malibu Hybrid	46
Percent Improvement	**44%**

[9] HEVs are defined by the Internal Revenue Code (*see* 26 United States Code [U.S.C.] § 30B(d)(3)).

[10] EISA Section 142 (42 U.S.C. § 6374e(a)(2)) requires Federal fleets to achieve at least a 10% increase in annual alternative fuel use relative to an FY 2005 baseline by FY 2015 and for each year thereafter.

4.2.2 Federal Fleet Locations Suited for Hybrid Electric Vehicles

Acquiring HEVs is an effective measure to reduce petroleum use in **locations where alternative fuel is unavailable.** Because Federal agencies receive AFV acquisition credits for HEVs, acquiring HEVs in these fleet locations (in lieu of E85 FFVs or other dual-fueled vehicles) may also help agencies reduce the number of waivers submitted under Section 701 of EPAct 2005.[11] However, in fleet locations with reasonable and affordable access to alternative fuel, acquisition of AFVs will provide greater petroleum reductions than that achieved by an HEV—alternative fuel used by an AFV displaces the petroleum that would be used in an HEV or a conventional-fueled vehicle.

4.2.3 Hybrid Electric Vehicles Receive Credits Toward EPAct 1992 Alternative Fuel Vehicle Acquisition Requirements

The National Defense Authorization Act (NDAA) of 2008 expanded the definition of an AFV to include qualified hybrid electric, lean burn technology, and fuel cell vehicles, as well as any other type of vehicle that can reduce petroleum consumption as demonstrated by the EPA to the Secretary of Energy.

As a result, agencies receive one EPAct 1992 AFV acquisition credit for each qualifying HEV acquired regardless of weight class. Federal agencies are responsible for ensuring that acquired HEVs meet the definitions and requirements at Section 30B(d)(3) of the Internal Revenue Code of 1986 to obtain EPAct 1992 AFV acquisition credit.

4.3 Maintaining Vehicles to Improve Vehicle Fuel Economy

In addition to choosing fuel-efficient vehicles, fleet managers and drivers can keep fleet vehicles properly maintained to improve fuel economy. GSA FMR Bulletin B-19 encourages agency fleet managers to incorporate the following recommendations into preventive maintenance programs and driver inspections[12]:

- **"Keep your vehicle engines properly tuned.** Always check the vehicle Owner's Manual for proper maintenance and follow your agency's internal procedures for obtaining services on your vehicle. [Fixing a serious maintenance problem, such as a faulty oxygen sensor, can improve your mileage by as much as 40 percent.][13]
- **Keep tires properly inflated to the recommended tire pressure.** Under-inflated tires increase rolling resistance, reduce fuel economy, and cause tires to wear more rapidly.
- **Check and replace air filters regularly.** Replacing a clogged air filter protects the engine and may increase your fuel economy.
- **Use the recommended grade of motor oil for your vehicle to increase fuel economy.** Also, look for motor oil that reads, 'Energy Conserving' on the [American Petroleum Institute] performance symbol to be sure it contains friction-reducing additives.

Agency fleet managers can use telematics to create preventive maintenance schedules and proactively address fault codes. Telematics collect data to support condition-based maintenance to both ensure the vehicle is operating efficiency and reduce unnecessary maintenance costs. Additionally, telematics provides access to diagnostic trouble codes that can help fleets identify vehicle problems early and reduce downtime.

[11] Section 701 of EPAct 2005 requires Federal agencies to use alternative fuel in their dual-fueled vehicles except where the vehicles have received a waiver from DOE.
[12] GSA (2008). "FMR Bulletin 19: Increasing the Fuel Efficiency of the Federal Motor Fleet," available at www.gsa.gov/policy-regulations/regulations/federal-management-regulation/federal-management-regulation-fmr-related-files#FMRBulletins.
[13] DOE and EPA: Keeping Your Vehicle in Shape, available at www.fueleconomy.gov/feg/maintain.jsp.

4.4 Driving More Efficiently

Federal fleet vehicle drivers can help improve fuel economy and reduce petroleum use by driving more efficiently. GSA FMR Bulletin B-19 recommends that agency fleet managers "develop and implement a communication plan to ensure that strategies for improving fleet fuel efficiencies are disseminated agency-wide and that all drivers are aware of fuel efficiencies gained by driving more efficiently." The communication plan should include the following:

- **Drive at speeds that conserve fuel.** EPA estimates a 7 to 23 percent improvement in fuel economy by keeping your speed under 60 miles per hour (mph).
- **Use cruise control, when appropriate, on the highway to maintain a constant speed.** Cruise control should not be used in mountainous terrains as it increases fuel usage.
- **Drive safely and responsibly.** Accelerating smoothly from a stop and braking softly helps conserve fuel. Fast starts and hard braking waste fuel. This type of driving also wears out car components, such as brakes and tires. Drivers should maintain a safe distance between vehicles to allow more time to brake and accelerate gradually.
- **Remove excess weight such as unnecessary items in the trunk.** Carrying extra weight makes the engine work harder thus consuming more fuel. DOE estimates that an extra 100 pounds in the trunk reduces a typical car's fuel economy by 1 to 2 percent.

Fleet managers can also use vehicle telematics to help support driving behaviors that improve fuel efficiency. For example, telematics data can be used to identify speeding and rapid acceleration, and opportunities to coach drivers in driving more efficiently.

4.5 Avoiding Excessive Idling

When idling, vehicles typically burn from 0.16 (for a small passenger car) to 1.5 (for a loaded bucket truck) gallons of fuel per hour.[14] Unnecessary idling pollutes the air, wastes fuel, and causes excess engine wear, and reducing idle time is a simple policy to implement.

Idle reduction is commonly used with HDVs like semi-tractors and buses. However, light-duty vehicles (LDVs) and MDVs can benefit from idle reduction strategies as well. Typically, the following actions can help reduce unnecessary vehicle idling:

- Turn off your engine when you are parked or stopped (except in traffic) for more than 1 minute
- Avoid using a remote vehicle starter, which encourages unnecessary idling
- Avoid drive-through windows; walk inside instead.

For HDVs, a variety of technologies are available to reduce idling. Onboard equipment, such as automatic engine stop-start controls and auxiliary power units, can be used anywhere. Truck stop electrification enables trucks to hook up to stations that provide power and other amenities.

For LDVs and MDVs, three types of idle reduction technologies are available to keep vehicles warm: coolant heaters, air heaters, and energy recovery systems. Coolant heaters keep the engine warm by using fuel from the vehicle to pump heated coolant through the engine, radiator, and heater box. To provide passenger compartment warmth, air heaters are separate, self-contained units that directly blow hot air into the vehicle

[14] Argonne National Laboratory, Energy Systems Division, "Vehicle Idle Reduction Savings Worksheet (PDF)," available at https://www.anl.gov/es/reference/vehicle-idle-reduction-savings-worksheet-pdf.

interior using fuel from the vehicle. Energy recovery systems use electric pumps connected to the water line to keep the car's cooling system and heater operating after the engine is turned off, using engine heat that would otherwise dissipate.

There are many tools available to fleet managers to identify potential idling reduction technologies. For example, the Argonne National Laboratory Energy Systems Division has developed a list of solutions organized by stationary power needs (e.g., idle management, heat only, cooling only, auxiliary power unit, power take-off, cargo refrigeration, and wayside power/truck stop electrification).[15] DOE offers a toolkit on vehicle idling reduction[16] and EPA provides a list of SmartWay verified idling reduction technologies for trucks and school buses.[17]

Many states and localities have enacted legislation limiting idling, which often apply to different vehicle types (i.e., weight classes) depending on the location. The Alternative Fuels Data Center (AFDC) maintains a list of current incentives and laws related to idle reduction.[18]

[15] Available at www.anl.gov/es/reference/idling-reduction-technology-solutions-for-class-18-vehicles.
[16] Available at cleancities.energy.gov/technical-assistance/idlebox/.
[17] Available at www.epa.gov/verified-diesel-tech/learn-about-idling-reduction-technologies-irts-trucks-and-school-buses.
[18] Available at www.afdc.energy.gov/laws/.

5 Use Alternative Fuels to Displace Petroleum Use

One effective strategy to reduce petroleum use is to displace it with alternative fuels, including electricity, biodiesel blends, and renewable diesel blends.[19] Alternative fuels have additional advantages as well. Most are produced domestically, benefitting the national economy, and oftentimes they are more affordable than gasoline or diesel. Agencies should decide on the type of AFV and infrastructure based on fleet location characteristics.

To promote increased alternative fuel consumption by AFVs in the Federal fleet, Section 701 of EPAct 2005 requires Federal agencies to use only alternative fuel in its dual-fueled vehicles, except where the vehicles have received a waiver from DOE due to the local unavailability of alternative fuel or fuel that is unreasonably more expensive than gasoline (i.e., costs more per gallon). This means, for example, that if E85 infrastructure is available at or near a fleet location, all fleet E85 FFVs operating at that location are required to refuel solely with E85 using that infrastructure. Agencies are encouraged to focus on deploying dual-fueled AFVs in locations with existing or planned alternative fuel infrastructure and deploying new alternative fuel infrastructure near high concentrations of dual-fueled vehicles waivered due to the unavailability of fuel.

Alternative fuels include but are not limited to electricity, E85 (a fuel blend of 85% ethanol and 15% gasoline), B100,[20] R100,[21] CNG, LNG, H_2, and LPG or propane.

- **Electricity.** Electricity use requires both EVs, which include BEVs, low-speed electric vehicles (LSEVs), and PHEVs, and dedicated charging infrastructure.

- **E85, CNG, LNG, and LPG.** The use of these alternative fuels requires both AFVs and dedicated refueling infrastructure. These alternative fuels are best used at fleet locations where alternative fuel is currently available or expected to become available (i.e., emerging markets) or at high-use locations where alternative fuel sites are planned in the near term.

- **Neat biodiesel and biodiesel blends.** Neat biodiesel and biodiesel blends require dedicated refueling infrastructure but can be used in conventional diesel vehicles. Biodiesel strategies are ideal for locations with high diesel fuel use.

- **Neat renewable diesel and renewable diesel blends.** Neat renewable diesel and renewable diesel blends are “drop-in” replacement fuels for diesel; renewable diesel is fully compatible with existing diesel refueling infrastructure and engines. Replacing diesel fuel with renewable diesel is an effective petroleum reduction strategy at most fleet locations with diesel vehicles.

To maximize alternative fuel use increases and petroleum reductions, agencies should support strategies to increase alternative fuel use by:

- Acquiring AFVs, including BEVs and PHEVs, and placing them in or near areas with existing or planned alternative refueling sites (agencies should ensure alternative fuel infrastructure, including charging infrastructure and the associated fuel necessary to support dedicated AFVs, is in place before accepting delivery of vehicles); and by running dual-fueled vehicles on alternative fuel.

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[19] Biodiesel blends refer to blends of greater than 20% biodiesel with diesel (e.g., B20). Renewable diesel blends refer to blends of greater than 20% renewable diesel with diesel (e.g., R20).
[20] Biodiesel blends are not alternative fuels. However, the neat biodiesel component of biodiesel blends greater than 20% is counted as biodiesel in calculating fleet alternative fuel use.
[21] Renewable diesel blends are not alternative fuels. However, the neat renewable diesel component of biodiesel blends greater than 20% is counted as renewable diesel in calculating fleet alternative fuel use.

- Installing alternative fuel infrastructure (including EV charging infrastructure) in fleet locations with the highest AFV concentrations that use that fuel type.
- Communicating and coordinating with nearby fleets (both public and private sector) to aggregate demand for alternative fuel in which those other fleets have interest or need.

5.1 Basics of Using Alternative Fuels in Fleet Vehicles

5.1.1 E85 Use in E85 Flex-Fuel Vehicles

Ethanol is a renewable fuel made from various plant materials collectively known as "biomass." Most ethanol fuel today is produced using corn and is blended into U.S. gasoline as E10 (a fuel blend of 10% ethanol and 90% gasoline) or E15 (a fuel blend of 15% ethanol and 85% gasoline) to oxygenate the fuel, which reduces air pollution. Ethanol blended as E10 and E15, however, is not classified as an alternative fuel.

E85 (or flex fuel) is an ethanol-gasoline blend containing 51%–83% ethanol, depending on geography and season. E85 can only be used in FFVs, which have an internal combustion engine and are designed to run on E85, gasoline, or any blend of gasoline and ethanol up to 83%. E85 is not approved for use in conventional gasoline-powered vehicles, although conventional fuel can be used in FFVs. Thousands of fueling stations offer E85 in the United States; they can be found on the AFDC Alternative Fueling Station Locator.[22]

It is important to note that a gallon of ethanol contains less energy than a gallon of gasoline, resulting in lower fuel economy when operating your vehicle. For the Federal fleet, the fuel conversion factor used in FAST assumes that, on average, E85 blends contain about 72% of the energy content of gasoline.

5.1.2 Biodiesel and Renewable Diesel Use in Diesel Vehicles

Biodiesel is a renewable, biodegradable fuel manufactured domestically from vegetable oils, primarily from soybeans. For the Federal fleet, only B100 and the biodiesel component of blends greater than 20% (B20 and higher) are counted towards agency alternative fuel use.

B20 is the most common biodiesel blend, and offers a good balance of cost, emissions, cold-weather performance, materials compatibility, and ability to act as a solvent. B20 must meet prescribed quality standards as specified by ASTM D7467 and can be used in current engines without modifications. Engines operating on B20 have similar fuel consumption, horsepower, and torque to engines running on petroleum diesel. B20 has 1%–2% less energy per gallon than petroleum diesel.[23] Hundreds of fueling stations offer B20 in the United States; they can be found on the AFDC Alternative Fueling Station Locator.

Renewable diesel, or R100, is a "drop-in" replacement for diesel—it is produced from biomass but also meets the petroleum diesel fuel specification (ASTM D975) requirements. Renewable diesel uses similar renewable feedstocks as biodiesel, but the production process is different, typically through the same processes used to produce petroleum-based diesel. As a result, renewable diesel typically meets the specification for diesel (has same chemical structure as diesel) and can serve as a drop-in replacement to petroleum diesel in diesel vehicles at any blend level, but is most often used as R100.

5.1.3 Electricity Use in Plug-in Electric Vehicles

Electricity is considered an alternative fuel under EPAct 1992. Electricity can be produced from a variety of energy sources, including oil, coal, nuclear energy, hydropower, natural gas, wind energy, solar energy, and stored H_2. EVs are capable of drawing electricity from off-board electrical power sources (generally the electricity grid) and storing it in batteries.

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[22] Available at afdc.energy.gov/stations.
[23] Information available at afdc.energy.gov/fuels/biodiesel_blends.html.

EVs are vehicles that use electric motors powered by onboard sources of stored energy for propulsion. This definition includes the following general types of EVs:

- **Battery electric vehicles.** BEVs or "all electric vehicles" are powered by an electric motor drawing current from a battery (with a capacity of at least 4 kWh) that can be recharged from an external source of electricity (e.g., the grid). Commercial availability of light-, medium-, or heavy-duty BEVs is expected to continue to increase in coming model years.

- **Low-speed electric vehicles.** LSEVs are electric-powered low-speed vehicles. LSEVs are also referred to as neighborhood electric vehicles (NEVs). LSEVs are four-wheeled vehicles weighing less than 3,000 pounds with top speeds of 20–25 mph. LSEVs are not classified as "motor vehicles" for purposes of the EPAct 1992 AFV acquisition requirements and, therefore, do not receive AFV acquisition credits.

- **Plug-in hybrid electric vehicles.** PHEVs are propelled by both an internal combustion and heat engine and to a significant extent by an electric motor that draws electricity from a battery (with a capacity of at least 4 kWh) that can be recharged from an external source of electricity (e.g., the grid).

HEVs draw propulsion energy from onboard sources of stored energy that are both an internal combustion and heat engine using consumable fuel and a rechargeable energy storage system, often a chemical battery. These vehicles differ from the other EVs in that they **do not** consume electricity from an external source.

EVs are "fueled" with electricity by plugging into an electric vehicle charging station powered from the grid or directly from a generation source. The type of charging infrastructure varies based on the type of EV and charging characteristics (frequency, length, etc.). Most charging will occur at charging stations at the fleet sites, with additional charging at publicly accessible locations.

5.1.4 Hydrogen Fuel Use in Fuel Cell Electric Vehicles

H_2, when used in a fuel cell to provide electricity, is an emissions-free alternative fuel. Steam reforming natural gas is the most common way to produce H_2 in the United States, but electrolysis can also separate H_2 from water. Electrolysis can be powered through renewable energy, reducing emissions associated with H_2 production.

H_2 for vehicle use is stored in high-pressure tanks on vehicles (typically 10,000 pounds per square inch [psi]) and fueling stations to enable greater driving range and storage capacity. H_2 is used to power fuel-cell electric vehicles (FCEVs) that use fuel cells to convert H_2 to electricity, producing only water and heat as byproducts. FCEVs use electric motors for propulsion and may be considered a type of EV, although H_2 is listed as a separate alternative fuel in federal statute (42 U.S.C. § 13211). As of 2020, there were more than 40 public H_2 fueling stations in the United States, most of which are in California, although the number is growing annually.

5.1.5 Natural Gas and Renewable Gas Use in Compressed Natural Gas and Liquefied Natural Gas Vehicles

Natural gas is an odorless, gaseous mixture of hydrocarbons—predominantly comprised of methane. Most natural gas in the United States is considered a fossil fuel. A small portion is defined as renewable natural gas, also known as biomethane, which is a pipeline-quality vehicle fuel produced from organic materials—such as waste from landfills and livestock—through anaerobic digestion.

Two forms of natural gas, which are also defined at alternative fuels under EPAct 1992, are currently used in vehicles: CNG and LNG. CNG is compressed to less than 1% of its volume at standard atmospheric pressure and stored onboard a vehicle in a compressed gaseous state at a pressure of up to 3,600 psi. A CNG-powered vehicle gets about the same fuel economy as a conventional gasoline vehicle on a gasoline gallon equivalent (GGE) basis.

LNG is natural gas in its liquid form, produced by purifying natural gas and super-cooling it to -260°F to turn it into a liquid. LNG must be kept at cold temperatures and is stored in double-walled, vacuum-insulated pressure vessels. LNG is most suitable for trucks that require longer ranges because liquid is denser than gas and, therefore, more energy can be stored by volume. LNG is typically used in MDVs and HDVs. One GGE equals about 1.5 gallons of LNG.

CNG and LNG can only be used in vehicles designed for its use. There are three types of natural gas vehicles:

- **Dedicated:** These vehicles are designed to run only on natural gas.
- **Bi-fuel:** These vehicles have two separate fueling systems that enable them to run on either natural gas or gasoline/diesel.
- **Dual-fuel:** These vehicles have fuel systems that run on natural gas but use diesel fuel for ignition assistance. This configuration is traditionally limited to HDVs.

More fuel can be stored onboard a vehicle using LNG because the fuel is stored as a liquid, therefore making its energy density greater than that of CNG.

There are roughly 1,000 publicly-accessible CNG fueling stations in the United States and fewer than 100 publicly-accessible LNG fueling stations. Most CNG and LNG refueling occurs at private stations at fleet locations.

5.1.6 Liquid Petroleum Gas Use in Liquid Petroleum Gas Vehicles

LPG,[24] or propane, is a three-carbon alkane gas (C_3H_8) stored under pressure inside a tank pressurized to about 150 psi, as a colorless, odorless liquid. LPG used in vehicles is specified as HD-5 propane (a mixture of propane with no more than 5% propylene and 5% other gases), primarily butane and butylene. The energy content of LPG is less than that of gasoline (74%) on a volume basis, so it takes more LPG fuel by volume to drive the same distance as that covered using gasoline.

There are two types of LPG vehicles: dedicated and bi-fuel. Dedicated LPG vehicles are designed to run only on propane, while bi-fuel LPG vehicles have two separate fueling systems that enable the vehicle to use either LPG or gasoline. Many fleets purchase LPG vehicles, such as trucks and buses, to reduce maintenance costs and avoid cold-start issues associated with using liquid fuels in colder climates. Thousands of fueling stations offer LPG in the United States, all of which can be found on the AFDC Alternative Fueling Station Locator.

5.2 Identifying Optimal Electric Vehicle Strategies

5.2.1 Petroleum Reduction Opportunities from Electric Vehicles

Replacing petroleum vehicles with EVs is an effective strategy to reduce fleet-petroleum use. Electricity used in EVs displaces the petroleum that would have been used to support that transportation mission. EVs may have higher up-front acquisition costs, but they have the potential to significantly reduce an agency's petroleum use and operating costs. The primary benefits for each type of EV are as follows:

- **BEVs.** Replacing a conventional-fueled vehicle with a BEV provides a 100% reduction in that vehicle's petroleum use. BEVs also reduce fleet operating costs since electricity and maintenance costs are typically far less than for comparable conventional-fueled vehicles.
- **LSEVs.** LSEVs have the potential to significantly reduce an agency's petroleum use and fleet operating costs in locations where fleet vehicles are used primarily to support campus-type operations, have low

[24] LPG is considered an alternative fuel under Section 301 EPAct 1992.

daily VMT, and have daily (or overnight) access to electricity for recharging. Although LSEVs are not classified as light-, medium-, or heavy-duty vehicles within the Federal fleet program, inventory, mileage, and electricity use data for those vehicles should be reported in FAST in order to receive credit for electricity use towards the EISA Section 142 alternative fuel use increase targets.

- **PHEVs.** Acquisition of a PHEV to replace a conventional-fueled vehicle is expected to provide substantial reductions in petroleum use, depending on the amount of electricity as well as the amount and type of conventional or alternative fuel used. PHEVs also allow drivers to switch to gasoline after depleting the electricity in their batteries.

Agencies should evaluate these potential EV benefits together with any potential drawbacks to determine when use of EVs makes sense for reducing petroleum use. Potential drawbacks of EVs compared to conventional-fueled vehicles may include higher incremental acquisition costs, longer refueling time (charge time), range constraints (primarily for BEVs and LSEVs), and for LSEVs, limitation to campus use.

5.2.2 Framework for Identifying Optimal Electric Vehicle Strategies

Strategies to acquire EVs to reduce petroleum consumption can be effective at any fleet location, regardless of number of vehicles or alternative fuel availability. Fleet managers should evaluate fleet location and vehicle operating characteristics in deploying EVs, including vehicle duty cycle (i.e., how the vehicle is used and typical driving range) and availability of electric vehicle supply equipment (EVSE), or charging infrastructure, to refuel EVs. Table 4 provides Federal fleet managers with a recommended framework for identifying optimal EV strategies at each fleet location based on fleet characteristics.

After deciding to pursue an EV strategy, fleet managers should consider the infrastructure needed to “fuel” or power the vehicles. Agencies should evaluate and procure the most appropriate charging station—also referred to as EVSE—that meets the unique characteristics of the fleet and facility. Agency planning should focus on ensuring that the EVSE will be operational once the EV enters service at the fleet location.

The type of infrastructure needed depends on the types of EV procured and the vehicle’s charging requirements (frequency, length, etc.). BEVs, PHEVs, and LSEVs all require EVSE to charge. However, EVSE needs are different for each of these vehicle types. Some BEVs, which usually have larger batteries, may require higher level EVSE (e.g., Level 2 [240-V charging stations]) compared to LSEVs, which may only need lowered powered charging (e.g., Level 1 [120-V electrical outlets]). Charging equipment for PHEVs varies based on operating characteristics, size of batteries, and charging cycle.

Table 4. Recommended Framework for Identifying Optimal Electric Vehicle Strategies

Step	Summary	Actions	Purpose
1	Identify conventional-fueled vehicles at fleet locations with existing charging stations	• Determine if existing charging infrastructure has the capacity to support additional fleet EVs, or if the fleet can cost-effectively install additional charging stations using the existing infrastructure • Evaluate vehicle parking and charging needs, considering opportunities where one EVSE port could support two vehicles	Locations with existing charging infrastructure may offer the most cost-effective opportunity to replace conventional vehicles with EVs, and each EVSE port may be able to serve the needs of more than one vehicle
2	Identify conventional-fueled vehicles that are not candidates to be replaced with AFVs or use biodiesel or renewable diesel	• Determine if the fleet location will have accessibility to alternative fuel, biodiesel blends, or renewable diesel blends (see Sections 5.3 and 5.4) • Evaluate vehicles that are not candidates to be replaced with AFVs or diesel vehicles	At locations that have or will have access to alternative fuel, biodiesel blends, or renewable diesel blends, fleet managers should acquire EVs after first prioritizing acquisition of vehicles capable of using the alternative fuel, biodiesel, or renewable diesel
3	Identify optimal EV strategies based on fleet operational and location characteristics	• Evaluate operating characteristics for each candidate vehicle, including average and maximum daily driving range, route, and driving cycle, to determine whether an EV can meet the vehicle mission needs • Identify opportunities to replace LDVs that operate solely within campus with LSEVs	Select optimal EV strategies
4	Evaluate availability of EVs to replace conventional-fueled vehicles	• Determine availability of BEVs, LSEVs, or PHEVs to replace conventional-fueled vehicles • Ensure that replacement options will serve the vehicle mission and charging requirements to not cause undue burden on fleet operations	Identify EVs available to complete necessary mission tasks
5	Evaluate life-cycle costs for acquisition of EVs and supporting charging infrastructure	• Determine whether EVs that match fleet requirements can be acquired at a reasonable and competitive life-cycle cost relative to competing vehicles (include costs for supporting charging infrastructure) • If not cost competitive, investigate whether funds can be made available based on compliance with fleet requirements.	Ensure that acquisition of EVs aligns with fleet resources

5.3 Identifying Optimal Renewable Diesel Strategies

Renewable diesel is a "drop-in" replacement for diesel—it is produced from biomass but also meets the petroleum diesel fuel specification (ASTM D975) requirements. Therefore, renewable diesel and renewable diesel blends are fully compatible with existing diesel vehicles[25] and existing refueling and distribution infrastructure. Federal fleets can **effectively reduce petroleum use by displacing diesel with renewable diesel and renewable diesel blend use** at any fleet location with existing diesel infrastructure or where renewable diesel is available at local commercial or private fleet stations.

Biodiesel contains fatty acid methyl esters and therefore, cannot be transported through the diesel supply chain (including pipelines) and requires dedicated refueling infrastructure. Renewable diesel meets the requirements for use in a diesel engine and is produced from nonpetroleum, renewable, predominantly hydrocarbon feedstock (rather than oxygenates). Renewable diesel can be produced through multiple processes and goes by various names, including hydrogenated esters and fatty acid diesel and hydrogenation derived renewable diesel. As those names suggest, it is typically produced through hydrogenation on a commercial scale. Renewable diesel's similar chemical composition to diesel may create fewer issues in cold weather (due to a lower cloud point) and improve storage stability and performance compared to biodiesel blends. This means that properly tuned renewable diesel can be used as a drop-in fuel blend component in an unmodified diesel motor vehicle engine and fuel injection system.

In evaluating opportunities to use renewable diesel or renewable diesel blends at a fleet location, fleet managers should first determine the number of diesel vehicles in their existing and projected vehicle inventory, as well as identify available fueling options at each fleet location. If the location has an existing diesel fueling infrastructure, the fleet manager should assess the potential to convert that fueling system to a renewable diesel or renewable diesel blends. As explained earlier, the conversion will likely be seamless because the fuel meets the diesel fuel ASTM standard. However, the availability and cost of the fuel may raise relevant concerns until the commercial-scale production of renewable diesel fuel expands. If renewable diesel or renewable diesel blends are available locally, the fleet manager should maximize the use of the fuel by its fleet diesel vehicles at that local infrastructure.

After deciding to deploy renewable diesel, fleet managers should maximize the acquisition of diesel vehicles capable of using the fuel. Because renewable diesel is managed the same as other diesel fuels, operator training should be to ensure all drivers use the available renewable diesel fuel rather than conventional diesel, whenever possible.

Does renewable diesel qualify as alternative fuel under EPAct 1992?

EPAct 1992 Section 301 defines alternative fuels, but this definition does not specify biodiesel or renewable diesel. However, the definition includes "fuels (other than alcohol) derived from biological materials" such that neat biodiesel (100% biodiesel or B100) is considered an alternative fuel. Biodiesel itself is defined in EPAct Section 312, as amended by the Energy Conservation Reauthorization Act (ECRA):

> 'Biodiesel' means a diesel fuel substitute produced from nonpetroleum renewable resources that meets the registration requirements for fuels and fuel additives established by the Environmental Protection Agency under [Section 211 of the Clean Air Act].

To qualify renewable diesel fuel as biodiesel and therefore an alternative fuel, the fuel in question must be (1) produced from nonpetroleum renewable resources; and (2) registered pursuant to EPA's registration framework under Section 211 of the Clean Air Act (CAA).

[25] Since renewable diesel meets or exceeds the petroleum diesel standard, using the fuel will not void any manufacturer's engine warranty.

If the renewable diesel in question is produced from nonpetroleum renewable resources, then the fuel meets the first requirement. If the fuel also is registered with EPA under CAA Section 211, then it would meet the definition of biodiesel, and therefore the fleet may count the renewable diesel used as alternative fuel.

For blends of biodiesel, only that portion of the fuel that is biodiesel may be counted as alternative fuel. In other words, a biodiesel blend such as B20 (a mixture of 20% neat biodiesel and 80% conventional diesel) is not considered an alternative fuel, but the 20% biodiesel portion of B20 is considered an alternative fuel.

If renewable diesel qualifies under EPAct 1992 and is used as R100, then all of that renewable diesel would be counted as alternative fuel. As with biodiesel, only the neat renewable diesel portion of a renewable diesel blend greater than 20% is considered alternative fuel. For example, if a fleet uses R20, 20% of the mixture qualifies as alternative fuel, and the other 80% does not.

5.4 Identifying Optimal Alternative Fuel Strategies, Including Biodiesel Blends

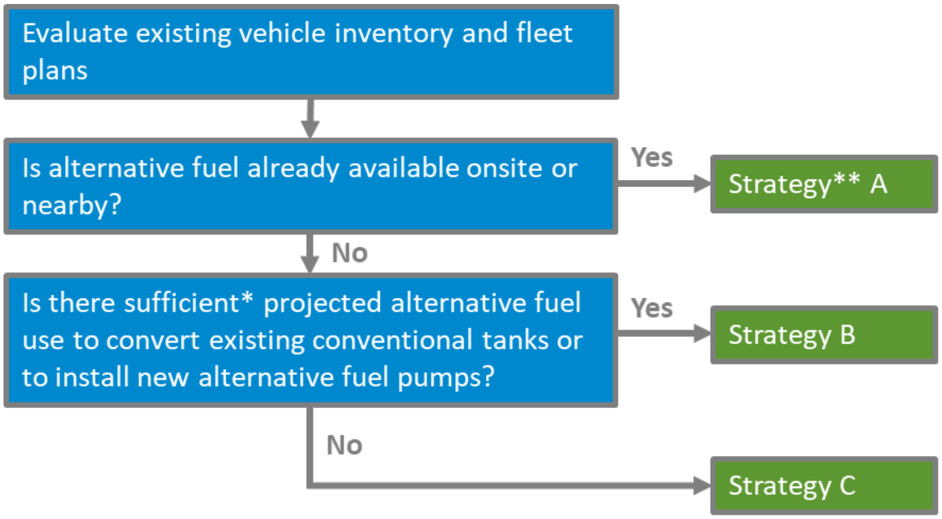
Liquid and gaseous alternative fuel strategies are ideally implemented at fleet locations with existing access to alternative fuel or high-use[26] locations where alternative fuel, including biodiesel or renewable diesel blends are not currently available. At facilities with low fuel throughput, or without access to alternative fuel, biodiesel, or renewable diesel, fleets should focus on other petroleum reduction strategies, such as acquisition of EVs (as discussed in Section 5.2), increasing fleet fuel efficiency (Section 4) or, if favorable, facilitate conversion of conventional gasoline tanks and/or development of alternative fuel, including biodiesel or renewable diesel infrastructure at local commercial or private fleet stations.

Fleet managers can identify the optimal liquid and gaseous alternative fuel strategies for each fleet location by using the flow chart in Figure 4 and the strategy descriptions in Table 5. To start, fleet managers should evaluate their existing and projected vehicle inventory (as discussed in Section 2) as well as identify available fueling options at each fleet location. The AFDC has various tools available to provide locations of alternative fuel pumps, such as the Alternative Fueling Station Locator.[27]

Having determined the availability of alternative fuels, including biodiesel blends, fleet managers should next determine which alternative fuels could be used at the location and to what extent. Fleet managers should first consider the FFVs—including E85 FFVs—and biodiesel-capable diesel vehicles that are already located at the site, and then consider planned vehicle acquisitions. Fleet managers can then estimate the maximum alternative fuel use for the fleet location using the following methodology:

- **Inventory of vehicles.** Use the most recent list of vehicle types approved for each fleet location and mission requirement developed in the VAM process.
- **Potential maximum number of AFVs.** Estimate the potential number of AFVs and diesel vehicles (including biodiesel-capable diesel vehicles) by fuel type at the fleet location for each of the next 5 fiscal years (FYs). First, project the number of vehicles, by size, required at the fleet location for each of the next 5 FYs. Then, determine how many of these vehicles can be AFVs or biodiesel-capable diesel vehicles, assuming maximum replacement of gasoline vehicles with AFVs and accelerated replacement, if possible.
- **Theoretical maximum alternative fuel use.** For each fuel type, multiply the potential maximum number of vehicles capable of using that fuel (AFVs or diesel vehicles) by the average fuel use of that vehicle type at the fleet location.

[26] High-use refers to locations with an annual fuel turnover rate of 100,000 gallons or greater of one conventional fuel type (i.e., gasoline or diesel).
[27] Available at afdc.energy.gov/stations/.



*Recommended usage threshold for alternative fueling stations:

- Conversion of gasoline tank to E85 ≥ 50,000 annual gallons
- Conversion of diesel tank to B20 ≥ 50,000 annual gallons
- Installation of new E85 or B20 tank ≥ 100,000 annual gallons

**See Table 5 for strategies A, B, and C

Figure 4. Determining liquid and gaseous alternative fuel strategies

Fleet managers should maximize the number of vehicles capable of using alternative fuel or biodiesel blends (AFVs and diesel vehicles) at those locations that have existing alternative fuel or biodiesel infrastructure or are candidates for new infrastructure. Fleet managers at both headquarters and fleet location levels should work with GSA and GSA Fleet Service Representatives to ensure that vehicle acquisition plans support alternative fuel and biodiesel blend strategies.

Success in implementing alternative fuel and biodiesel blend strategies depends not only on fuel availability, but also on vehicles that can use the fuels and drivers who consistently refuel with alternative fuel. Fleet managers can use the Fleet Sustainability Dashboard (FleetDASH)[28] to identify whether drivers are using alternative fuel when it is available within a three-mile radius of fueling transaction locations. Furthermore, FleetDASH can inform opportunities to acquire AFVs based on the how frequently each existing vehicle fuels near a certain alternative fuel and whether that type of AFV is available on the GSA schedule.

[28] Available at federalfleets.energy.gov/FleetDASH/.

Table 5. Strategies for Deploying Liquid and Gaseous Alternative Fuels

Strategy Heading	Summary	Infrastructure Strategy	Vehicle Acquisition Strategy	Fuel Use Strategy
A	• Optimize use of existing on-site infrastructure • Optimize use of nearby retail station(s) • Obtain access to nearby private fleet fueling center.	• Maximize use of existing on-site/ nearby alternative fuel infrastructure • Use AFDC or the Federal Highway Administration Alternative Fuel Corridors to locate options.	Focus on acquisition of vehicles capable of using the existing alternative fuel or biodiesel infrastructure	Implement measures such as operator training to locate existing alternative fuel including biodiesel pumps and monitoring to limit conventional fuel use by dual-fueled AFVs or diesel vehicles
B	• Convert conventional fuel tank to E85 or biodiesel • Install new alternative fuel or biodiesel infrastructure.	• Convert existing gasoline fueling system to E85 or diesel fueling system to biodiesel • Install new ethanol, biodiesel, LPG, or CNG pumps.	Focus on acquisition of E85 FFVs (for E85) and diesel vehicles (for biodiesel)	Implement measures such as operator training to use existing alternative fuel and biodiesel pumps (as much as possible) and monitoring to limit conventional fuel use by dual-fueled AFVs or diesel vehicles
C	• Promote development of local alternative fuel or biodiesel infrastructure • Consider other options, such as hybrid vehicles and EVs	• Work with local retail stations, the Clean Cities program, and other fleets to install alternative fuel or biodiesel infrastructure	Acquire AFVs or diesel vehicles if alternative fuel or biodiesel infrastructure is conveniently available	Ensure AFVs or diesel vehicles use new retail or private stations through operator training and monitoring

Glossary

Acquisition – A vehicle acquired for a Federal fleet that is a (1) new purchase; (2) newly leased vehicle, whether leased through GSA or commercially; or a (3) leased vehicle that replaces an existing leased vehicle. Leased acquisitions are counted in the FY in which they are ordered. For example, a vehicle that was ordered in FY 2019 (prior to September 30), but is delivered after October 1, 2019 (the start of FY 2020), will count as a FY 2020 acquisition. Similar/identical vehicles that are swapped within the same agency do not count as acquisitions (e.g., at GSA request, to ensure uniform vehicle usage across their fleet).

Agency owned vehicle – A vehicle purchased by a Federal agency.

Alternative fuel – "Methanol, denatured ethanol, and other alcohols; mixtures containing 85% or more (or such other percentage, but not less than 70%, as determined by the Secretary, by rule, to provide for requirements relating to cold start, safety, or vehicle functions) by volume of methanol, denatured ethanol, and other alcohols with gasoline or other fuels; natural gas, including liquid fuels domestically produced from natural gas; liquefied petroleum gas; hydrogen; coal-derived liquid fuels; fuels (other than alcohol) derived from biological materials; electricity (including electricity from solar energy); and any other fuel the Secretary determines, by rule, is substantially not petroleum and would yield substantial energy security benefits and substantial environmental benefits." *42 U.S.C. § 13211(2)*

Alternative fuel vehicle (AFV) – A vehicle that either operates solely on alternative fuel or that is capable of operating on both alternative fuel and gasoline or diesel fuel. This includes: "a new qualified fuel cell motor vehicle (as defined in Section 30B(b)(3) of Title 26); a new advanced lean burn technology motor vehicle (as defined in Section 30B(c)(3) of that title); a new qualified hybrid motor vehicle (as defined in Section 30B(d)(3) of that title); and any other type of vehicle that the EPA Administrator demonstrates to the [DOE] Secretary would achieve a significant reduction in petroleum consumption." *42 U.S.C. § 13211(3)*

Bi-fuel vehicle – A vehicle with two separate fuel systems designed to run on either an alternative fuel, or gasoline or diesel, using only one fuel at a time. Bi-fuel vehicles are sometimes referred to as dual-fueled vehicles, including in the Clean Air Act Amendments and Energy Policy Act.

Biodiesel – "A diesel fuel substitute produced from nonpetroleum renewable resources that meets the registration requirements for fuels and fuel additives established by the Environmental Protection Agency under Section 7545 of [U.S.C. Title 42]; includes biodiesel derived from animal wastes, including poultry fats and poultry wastes, and other waste materials; or municipal solid waste and sludges and oils derived from wastewater and the treatment of wastewater." *42 U.S.C. § 13220(f)(1)*

Compressed natural gas – Natural gas that has been compressed under high pressures, typically 2,000 to 3,600 psi, held in a container. The gas expands when used as a fuel.

Conventional fuel vehicle – A vehicle that is powered by an internal combustion engine that utilizes gasoline, reformulated gasoline, diesel fuel, or a biodiesel blend as its fuel source.

Dedicated alternative fuel vehicle – A motor vehicle that is designed to operate solely on alternative fuel.

Dual-fueled alternative fuel vehicle – Vehicle designed to operate on a combination of an alternative fuel and a conventional fuel. This includes (a) vehicles that use a mixture of gasoline or diesel and an alternative fuel in one fuel tank, commonly called flexible-fuel vehicles; and (b) vehicles capable of operating either on an alternative fuel, a conventional fuel, or both, simultaneously using two fuel systems. They are commonly called bi-fuel vehicles. *See* 42 U.S.C. § 13211(8).

Electric vehicle (EV) – A vehicle primarily powered by an electric motor that draws current from rechargeable storage batteries, fuel cells, photovoltaic arrays, or other sources of electric current. *See* 42 U.S.C. § 17011(3).

Emergency or emergency response vehicle – Any vehicle that is legally authorized by a government authority to exceed the speed limit to transport people and equipment to and from situations in which speed is required to save lives or property, such as a rescue vehicle, fire truck or ambulance. This includes vehicles directly used in the emergency repair of transmission lines and in the restoration of electricity service following power outages that are used in this capacity for more than 75% of the year. It also includes those vehicles that are used in an emergency capacity, by the agency, for more than 75% of the year.

Ethanol – A fuel that can be produced chemically from ethylene or biologically from the fermentation of various sugars from carbohydrates.

Flex-fuel (or flexible-fuel) vehicle (FFV) – A vehicle with a common fuel tank designed to run on varying blends of unleaded gasoline with either ethanol or methanol.

Fiscal year (FY) – For a given year, the 12-month period running from October 1 of the prior calendar year through September 30 of the given calendar year. For example, FY 2020 means October 1, 2019, through September 30, 2020.

Fuel cell – An electrochemical engine with no moving parts that converts the chemical energy of a fuel, such as hydrogen, and an oxidant, such as oxygen, directly to electricity. The principal components of a fuel cell are catalytically activated electrodes for the fuel (anode) and the oxidant (cathode) and an electrolyte to conduct ions between the two electrodes.

Fuel economy – The average number of miles traveled by an automobile for each gallon of gasoline (or equivalent amount of other fuel) used.

Gasoline gallon equivalent (GGE) - A unit for measuring alternative fuels so that they can be compared with gasoline on an energy equivalent basis. This is required because the different fuels have different energy densities.

Greenhouse gas (GHG) – Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and nitrogen trifluoride (NF_3).

Heavy-duty vehicle (HDV) – Generally, a vehicle that a) is rated at more than 8,500 pounds gross vehicle weight; b) has a curb weight of more than 6,000 pounds; OR has a basic vehicle frontal area in excess of 45 square feet.

Hybrid electric vehicle (HEV) – A vehicle powered by two or more energy sources, one of which is electricity. HEVs draw propulsion energy from onboard sources of stored energy which are both an internal combustion or heat engine using consumable fuel, and a rechargeable energy storage system – as defined in Section 30B(d)(3) of the Internal Revenue Code of 1986 as cited in EISA 2007. *See* 26 U.S.C. § 30B(d)(3).

Incremental cost – The additional cost of acquiring an AFV over a comparable conventionally fueled vehicle.

Law enforcement (LE) vehicle – A vehicle which is primarily owned, operated or controlled by Federal LE or protective services, AND which is primarily used for the purpose of LE activities such as (a) chase, apprehension, and surveillance of people engaged in or potentially engaged in unlawful activities, or (b) for site protection services. Typically, LE vehicles include those that are authorized to exceed speed limits and/or ignore other traffic laws, are used for chasing suspects, have flashing red and/or blue lights (mounted in either a marked or unmarked configuration), are used for detaining suspects or transporting prisoners, and/or are used to monitor and protect a Federal site’s perimeter, equipment, personnel, and/or entrance.

Light-duty vehicle (LDV) – Passenger cars and trucks with a gross vehicle weight rating of 8,500 pounds or less. *See* 42 U.S.C. § 13211(11).

Liquefied natural gas (LNG) – Compressed natural gas that is cryogenically stored in its liquid state.

Liquefied petroleum gas (LPG) – A mixture of hydrocarbons found in natural gas and produced from crude oil, used principally as a feedstock for the chemical industry, home heating fuel, and motor vehicle fuel. Also known by the principal constituent propane.

Low-speed electric vehicle (LSEV)– A 4-wheeled on-road or non-road vehicle that (1) has a top attainable speed in 1 mile of more than 20 mph and not more than 25 mph on a paved level surface; and (2) is propelled by an electric motor and an on-board, rechargeable energy storage system that is rechargeable using an off-board source of electricity.

Medium-duty vehicle (MDV) – A motor vehicle of more than 8,500 pounds and less than or equal to 16,000 pounds GVWR. Definitions vary by organization.

Methanol – A liquid fuel formed by catalytically combining carbon monoxide (CO) with hydrogen in a 1 to 2 ratio under high temperature and pressure. Commercially, it is typically manufactured by steam reforming natural gas. Also formed in the destructive distillation of wood.

Motor Vehicle – A self-propelled vehicle that meets the definition of Section 215(2) of the Clean Air Act (42 U.S.C. 7550(2)) and is fully Federal Motor Vehicle Safety Standards certified for operation on all public roads and highways, designed for transporting persons or property (**Automobile** means a 4-wheeled vehicle propelled by conventional fuel, or by alternative fuel, manufactured primarily for use on public streets, roads, and highways).

Neighborhood electric vehicle (NEV) – "A four-wheeled on-road or non-road vehicle that (1) has a top attainable speed in 1 mile of more than 20 mph and not more than 25 mph on a paved level surface and (2) is propelled by an electric motor and on-board, rechargeable energy storage system that is rechargeable using an off-board source of electricity." *42 U.S.C. § 13258(a)(4)*

Petroleum fuel – Gasoline or diesel fuel.

Renewable diesel – A diesel alternative produced from nonpetroleum renewable resources that serves as a drop-in substitute for petroleum diesel. To qualify as an alternative fuel, renewable diesel must be registered with EPA under CAA Section 211.

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