Session 10: Naval Air Station Whidbey Island Micro Climate Base Study

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NREL, Golden, Colorado
February 2016

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INL/MIS-16-37763

Background

- **This study evaluated the extent to which Naval Air Station Whidbey Island (NASWI) could convert their light-duty non-tactical internal combustion engine vehicles (ICEVs) to plug-in electric vehicles (PEVs)**
- **Charging infrastructure needs and likely locations were to also be identified**
- **NASWI is one of three DOD bases to complete a Micro Climate study. The others are:**
  - **Marine Corps Base Camp Lejeune**
  - **Joint Base Lewis McChord**
- **Department of Defense (DOD) signed a Memorandum of Understanding on July 22, 2010, with Department of Energy (DOE) to study and define the path towards electrifying its non-tactical Fleet**

Micro-Climate Tasks

- **Task 1, Assessment of Fleet Inventory for Naval Air Station Whidbey Island**
- **Task 2, Identification of Vehicles for Installation of Data Loggers for Naval Air Station Whidbey Island**
- **Task 3, Utilization Assessment of Target Electrification Vehicles at Naval Air Station Whidbey Island**
- **Task 4, Implementation Approach for Electric Vehicles at Naval Air Station Whidbey Island (NASWI)**

DOD Facility Selection Factors

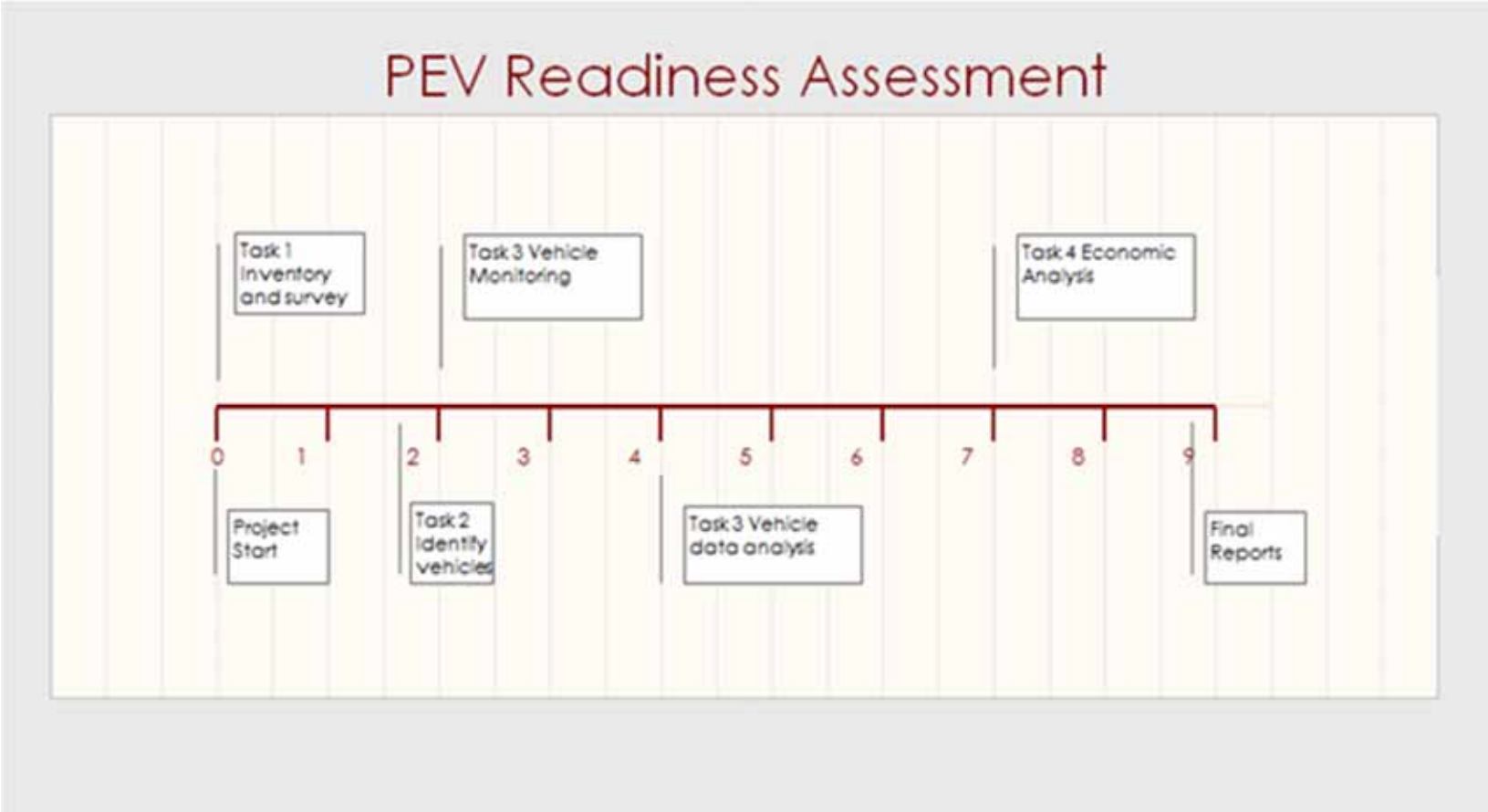
- **Relatively mild climate**
- **Existing vehicle types for which PEVs are or will soon be available**
- **A diverse and large inventory of fleet vehicles is available**
- **The local fleet community is receptive toward PEVs**
  - **Having local interest in adoption of PEVs creates a positive environment for employees and contractors to actively engage PEV usage**

Facility Support Requirements

- **Provide management support and directives/orders to accomplish project**
- **Identify key on-base support personnel**
- **Provide an inventory of existing vehicles**
- **Provide responses to vehicle survey questions**
- **Assist in the selection of 60 vehicles for data monitoring**
- **Install and remove the data loggers from the selected vehicles (the logger simply inserts into the vehicles on-board data (OBD) port) – a process taking less than 1 minute on each vehicle**
- **Provide information and schematics on the base electrical system**
- **Review and comment on generated reports from each task**

Typical Study Timeline

- **Each study typically requires approximately nine months for completion, but multiple studies can run concurrently**



NASWI Mission

- **NASWI is located on Whidbey Island on the Puget Sound in Washington State**
- **Home of all Navy tactical electronic attack squadrons flying the EA-6B Prowler and EA-18G Growler**
- **Four P-3 Orion Maritime Patrol squadrons**
- **Two Fleet Reconnaissance squadrons flying the EP-3E Aries**

Task 1, Assessment of Fleet Inventory for Naval Air Station Whidbey Island

Objective

- **Assessment of the existing non-tactical fleet of vehicles to characterize its current components in order to select representative vehicles for an in-depth assessment**
- **Leads to a wider extrapolation to the full fleet of vehicles**

Support Vehicle

Pool Vehicle

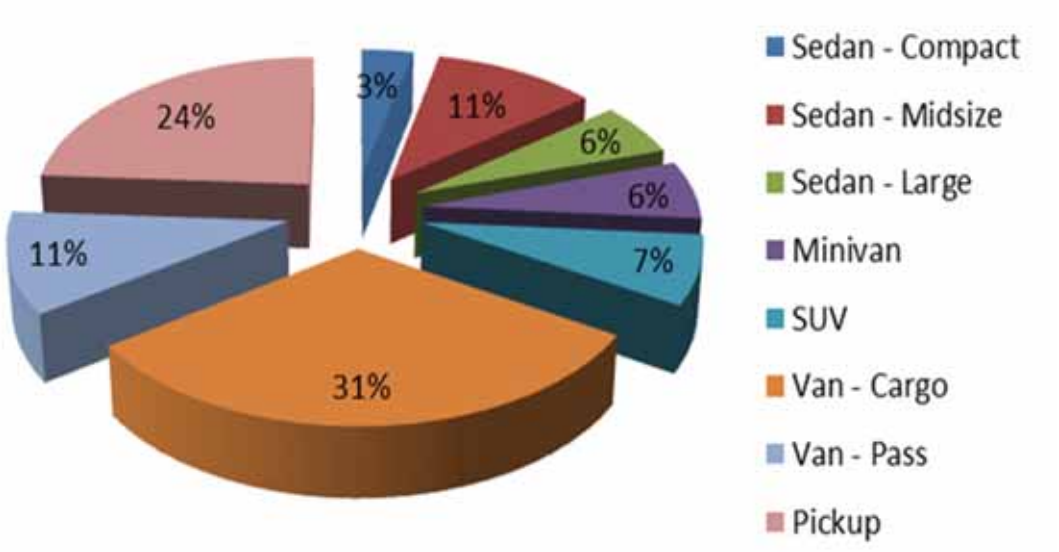
Enforcement Vehicle

Transport Vehicle

Fleet Inventory

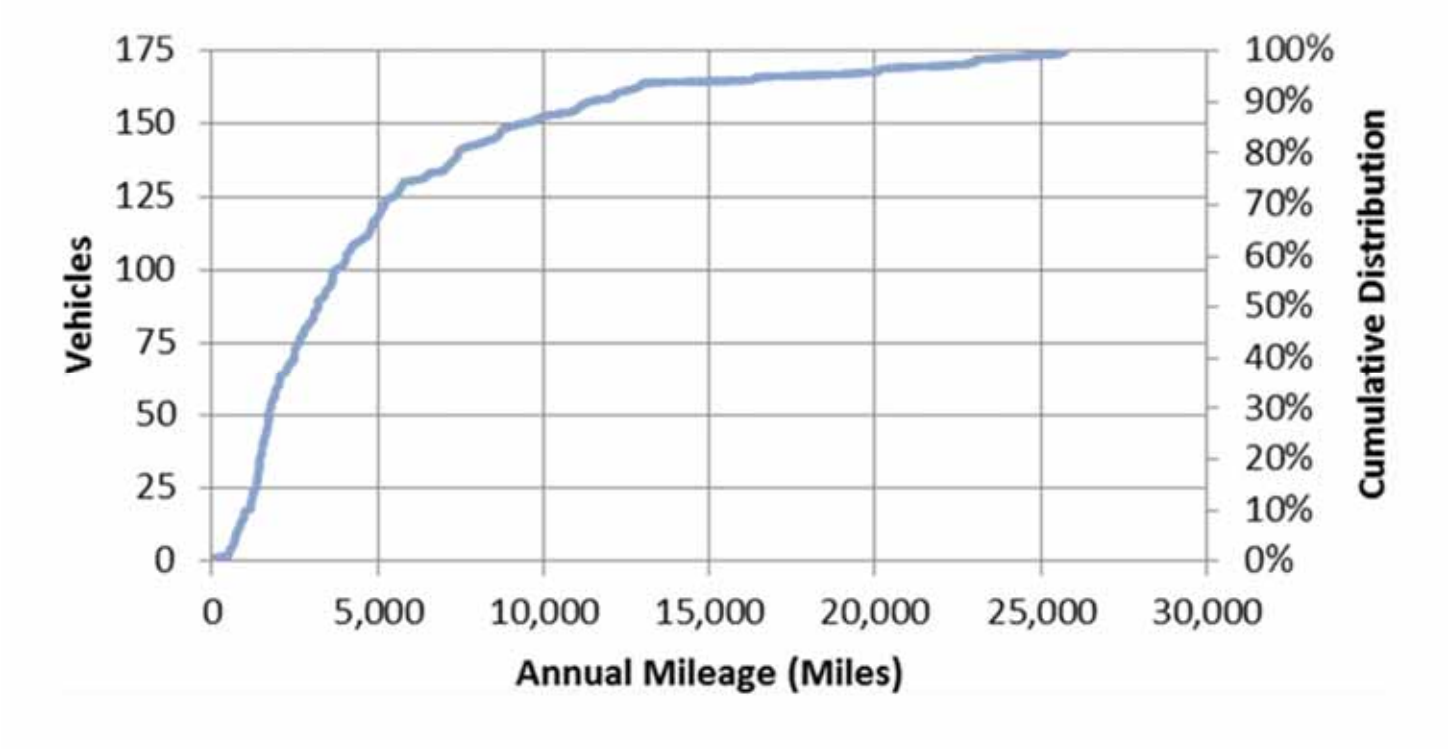
- **324 total vehicles, but 175 sedans, and light- and medium-duty trucks constituted the focus of the study**

	Sedan - Compact	Sedan - Midsize	Sedan - Large	Minivan	SUV	Van Cargo	Van Pass	Pickup	Total
Qty	6	19	10	11	13	55	19	42	175
Percent	3%	11%	6%	6%	7%	31%	11%	24%	100%



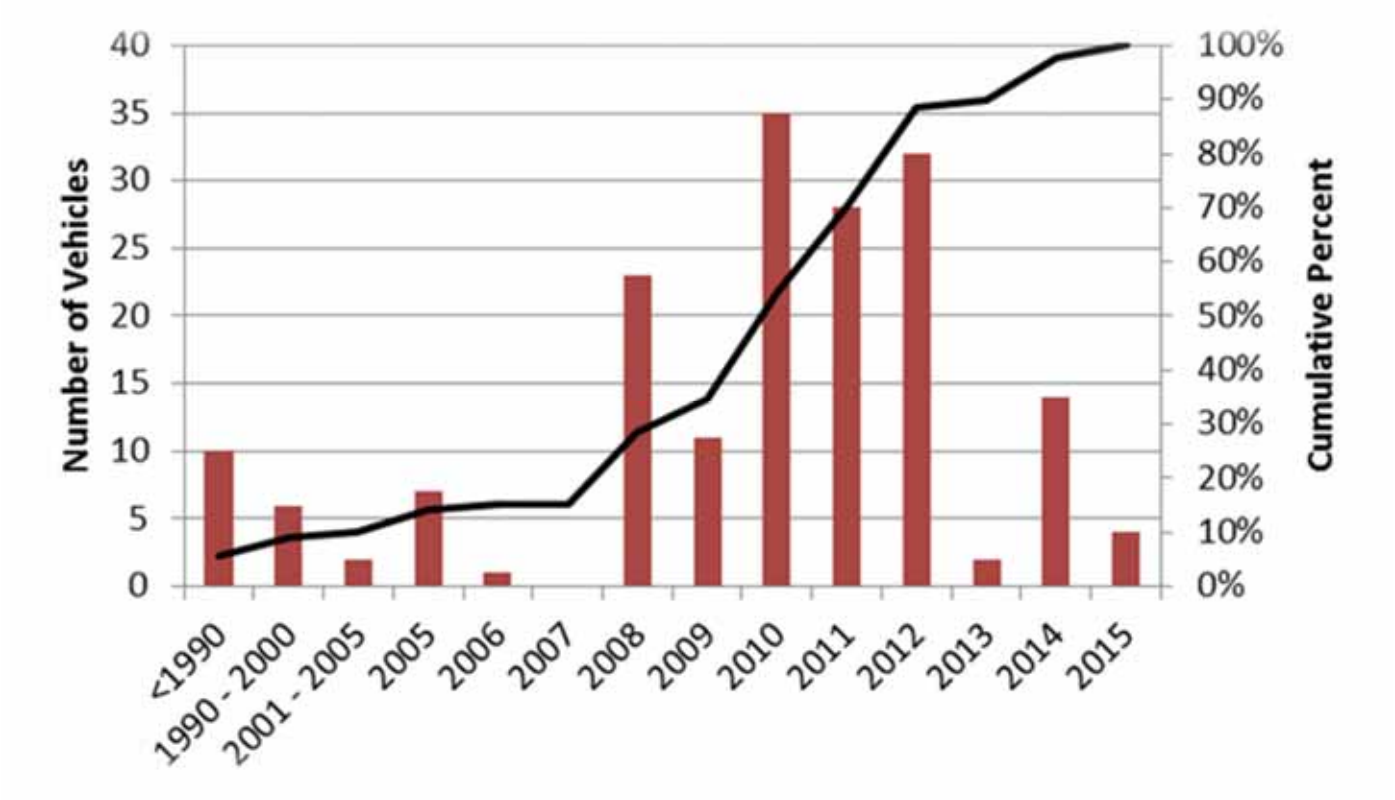
Fleet Mileage

- **68% of the vehicles are driven less than 5,000 miles annually (less than 100 miles per week)**
- **Eight vehicles with the heaviest usage are used in enforcement activities and exceed 20,000 miles annually**



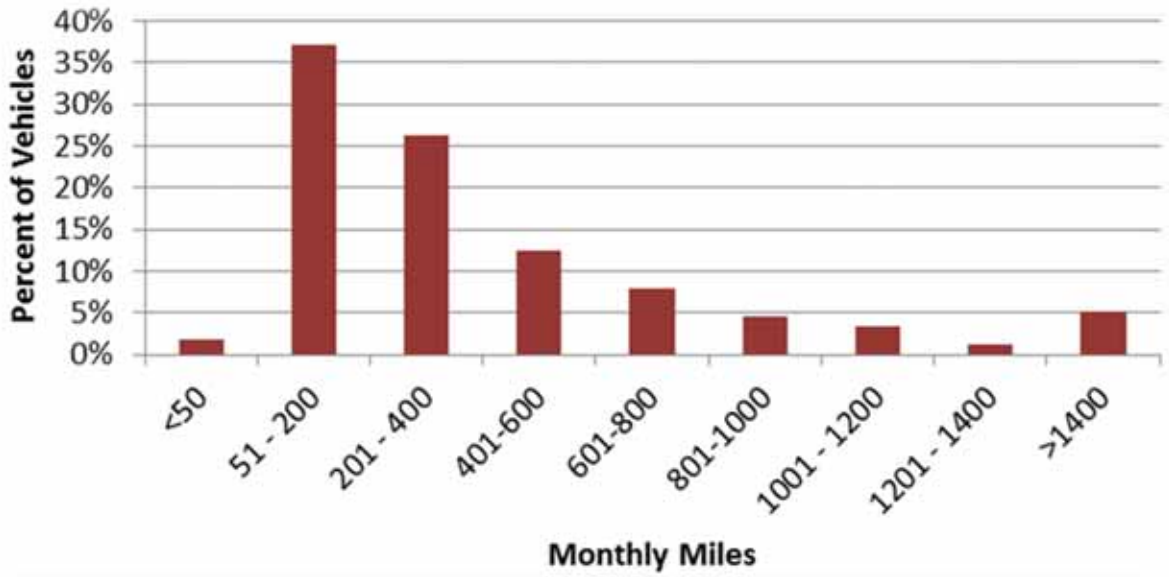
Fleet Inventory

- 65% of the vehicles having a model year 2010 or newer
- 9% are more than 10 years old
- The oldest vehicles is 1976 Chevrolet pickup (78,000 mi.)



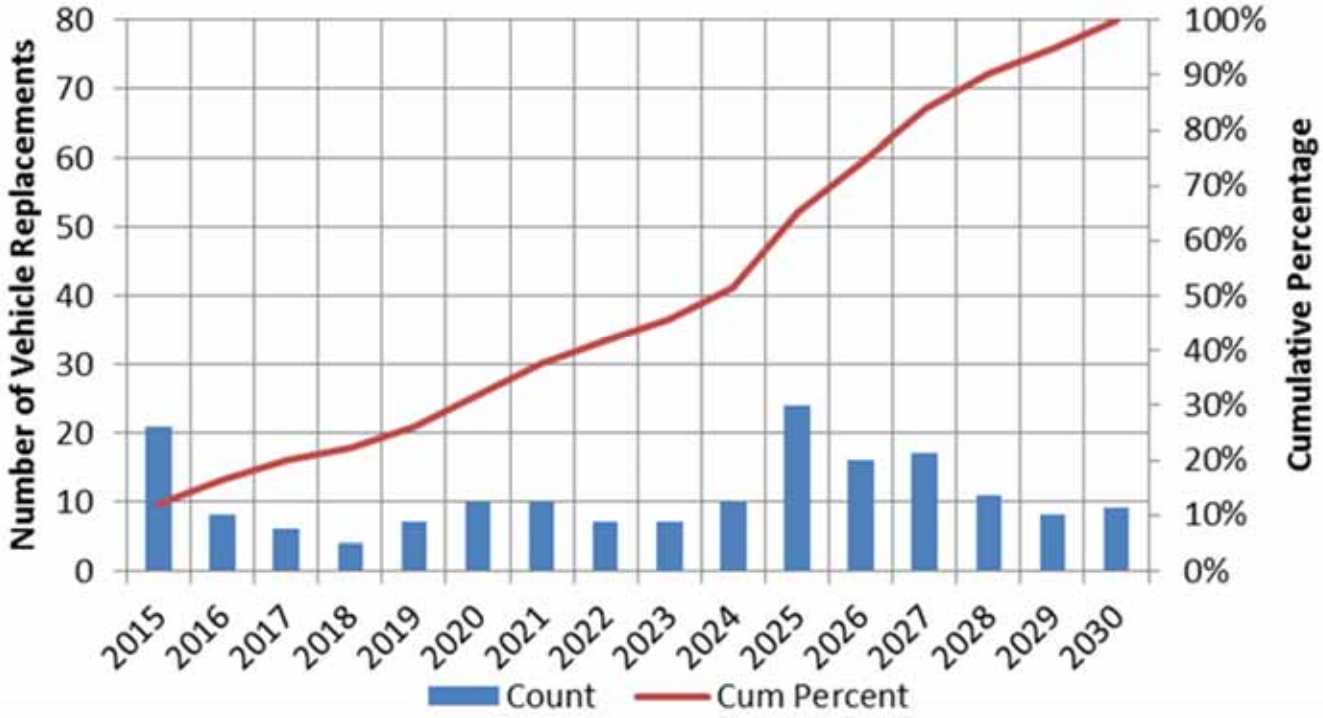
Monthly Mileage

- Assuming a battery range of 70 miles for a BEV and 21 working days per month, a vehicle would have to travel greater than approximately 1,500 miles per month to exceed the batter capacity on a monthly basis
- 95% of sedans, and light- and medium-duty trucks average travel that is less than 1,500 miles per month



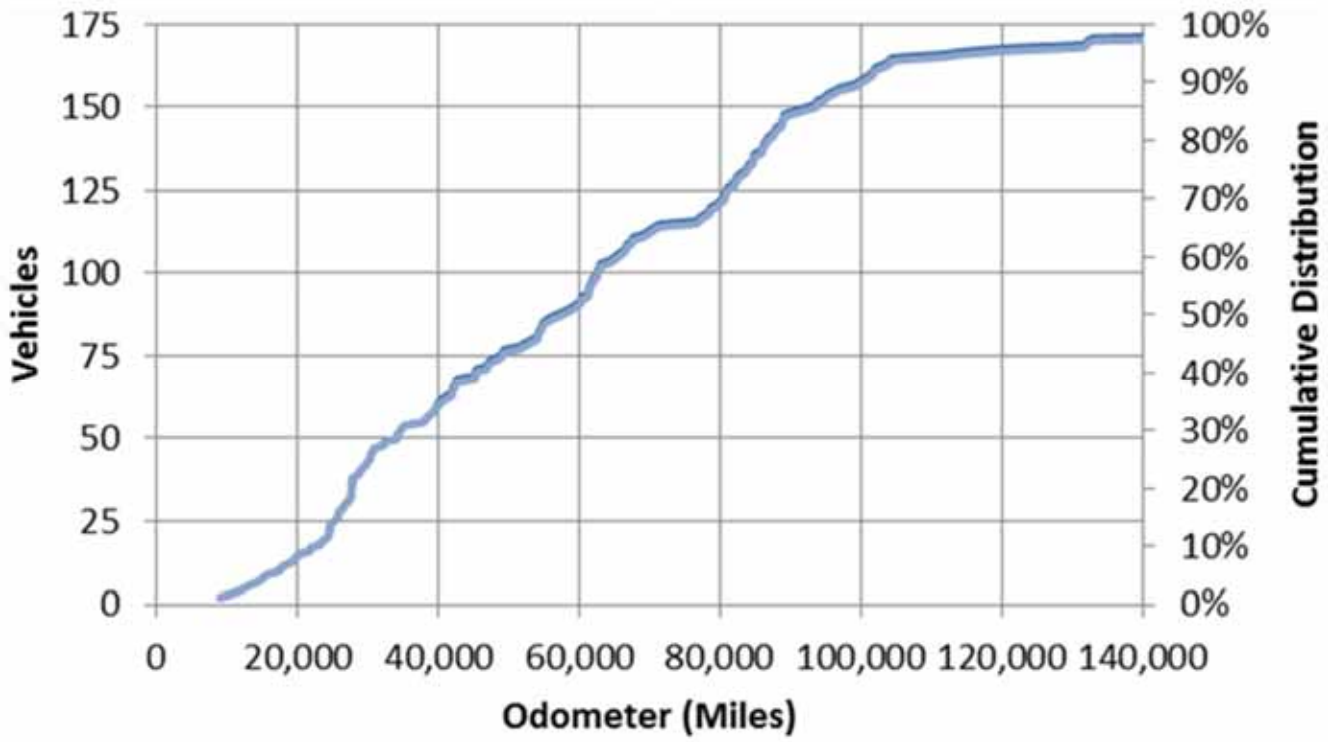
Vehicle Replacement Projections

- **NASWI typically exceeds GSA replacement requirements**
- **Extrapolating the annual miles from recent odometer readings, with GSA requirements as a minimum, the replacement year of these fleet vehicles is projected. Note that an upper limit of 2030 (15 years away) was arbitrarily used as the replacement of any remaining vehicles**



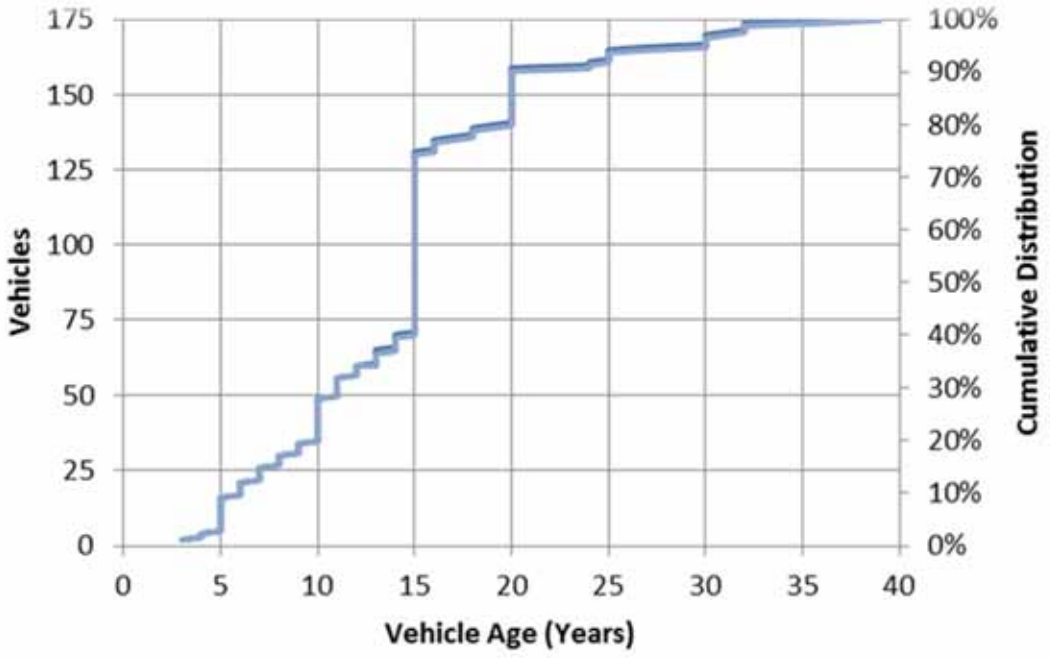
Vehicle Replacement Odometer Projections

- **Cumulative distribution of vehicle odometer readings at replacement**
- **The mean and median projected odometer readings of the replaced vehicles are 58,384 and 60,914 miles, respectively**



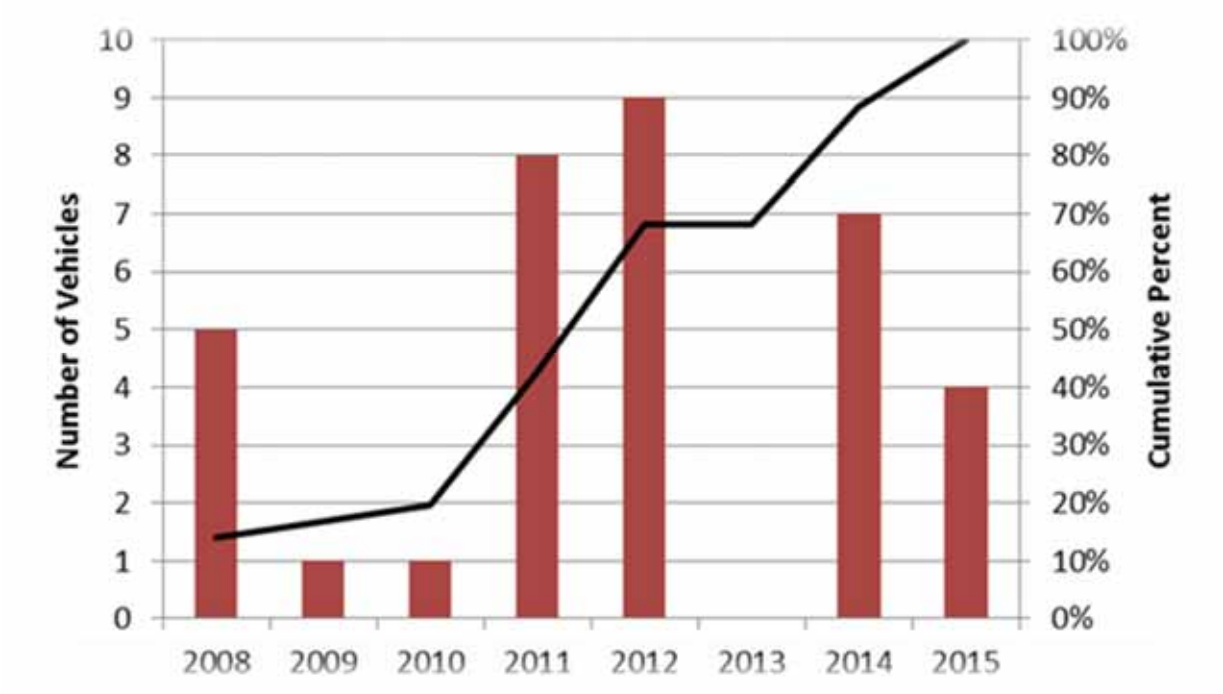
Vehicle Age At Projected Replacement.

- **15 years is the mean and median ages of the replaced vehicle**
- **The age of the vehicle at replacement almost always exceeds the GSA minimum requirements of 3 to 10 years**
- **The odometer reading at replacement exceeds the minimum for sedans (36,000) and is near the minimum for light trucks (65,000).**
- **This reflects the relatively low annual travel usage of the vehicles**



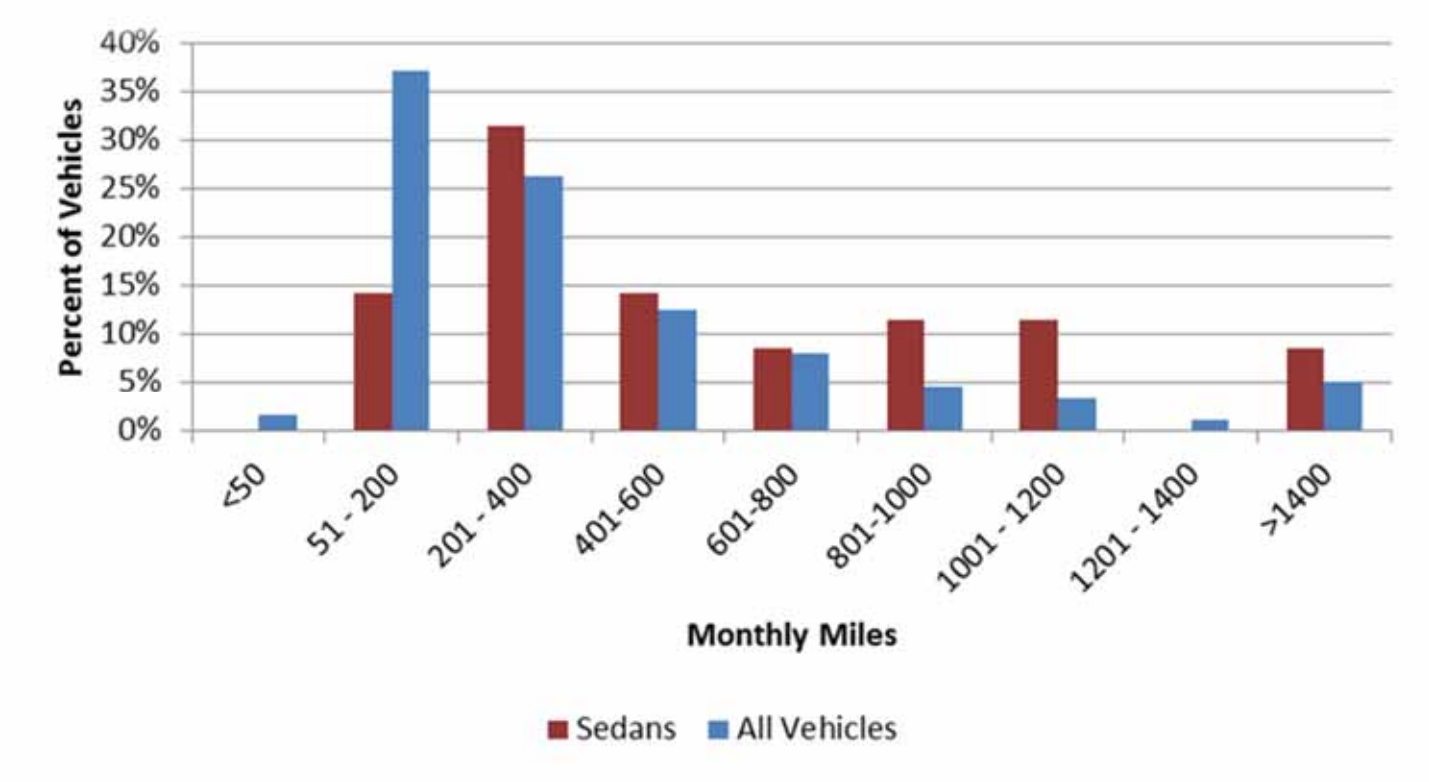
Age of Sedans

- **Sedans are reviewed separately because only sedan-type vehicles currently populate the GSA list for PEVs**
- **35 sedans are in the fleet of vehicles**
- **57% are model year 2012 or newer**



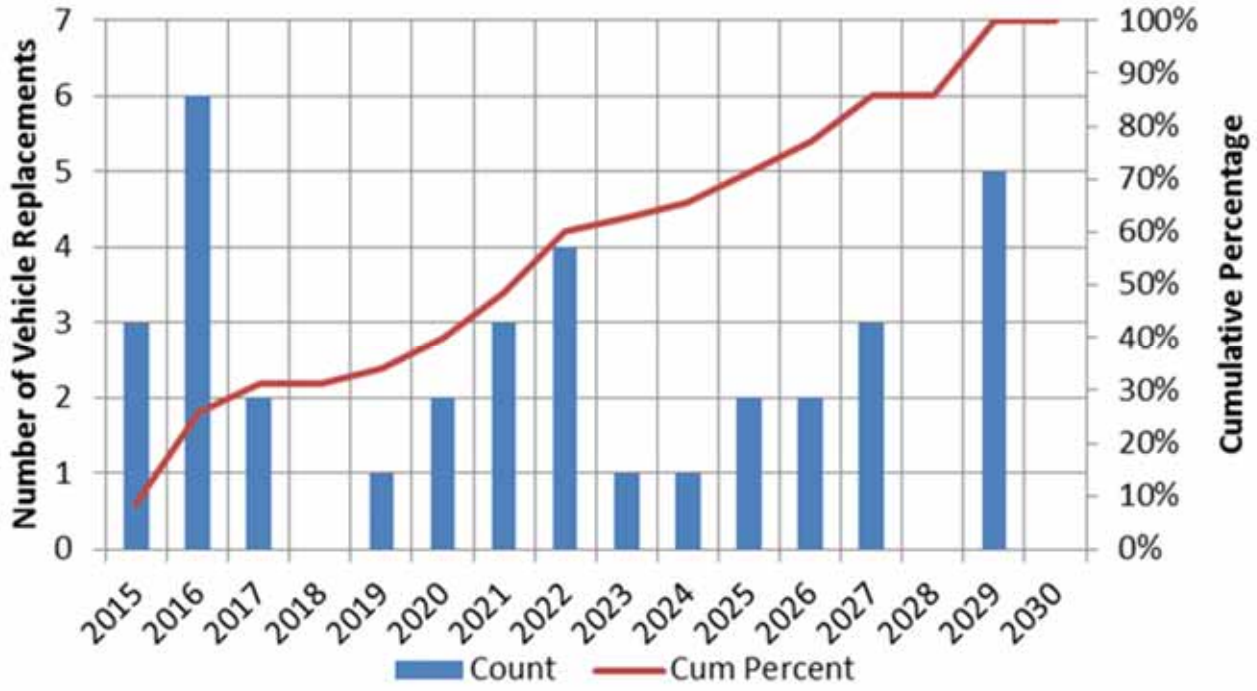
Sedans Monthly Mileage Distribution

- **Indicates that the range generally should not be a concern for PEV replacement**
- **Sedans generally have higher monthly usage than the average of all the vehicles studied**



Projected Year of Sedan Replacement

- The peaks in the next few years are due to the age of many of the vehicles, coupled with several vehicles having high mileage



Vehicle Assignments and Missions

- **Fleet vehicle assignments by vehicle catagory**

	Sedan - Compact	Sedan - Midsize	Sedan - Large	Minivan	SUV	Van Cargo	Van Pass	Pickup	Total
Commands	2	4	1	7	2	31	5	17	69
Departments	4	15	9	4	11	24	14	25	106
Total	6	19	10	11	13	55	19	42	175

- **Mission classifications for full fleet**

	Pool	Support	Enforcement	Transport	Specialty	Bus	Low-Speed Vehicle	Total
Total	21	138	25	22	66	2	20	294

- **Mission classifications for study vehicles**

	Pool	Support	Enforcement	Transport	Total
Commands		56		13	69
Departments	20	60	25	1	106
Total	20	116	25	14	175

Task 1. Summary

- **PEVs that are currently commercially available cannot replace certain vehicles and missions, such as those requiring heavy-duty trucks and specialty usage vehicles**
- **However, the NASWI non-tactical fleet contains 175 vehicles for which counterpart PEVs are currently available or are expected to be available in the near future**
- **From these 175 vehicles, 60 vehicles will be selected for further monitoring and evaluation.**

Task 2, Identification of Vehicles for Installation of Data Loggers for Naval Air Station Whidbey Island

Task 2. Objective

- **Of the 175 NASWI vehicles of interest, Task 2 would identify a 60-vehicle subset for further monitoring and evaluation via telematics**

Privacy Issues

- **Individual privacy concerns exist when monitoring vehicle movement with data loggers**
- **Data collection occurs by data logger number and vehicle identification number or agency-assigned vehicle number**
- **The study received no information related to the vehicle operator and provides no raw data to the fleet managers**
- **In this manner, the study does not collect, analyze, or report on individual staff driving habits**

Data Loggers

- Data was collected using non-intrusive data loggers placed into each vehicle's onboard diagnostic (OBD) port
- Installation of the data loggers and manual recording of information about the vehicle typically take less than 5 minutes and is completed by fleet managers or designees
- The data loggers transmit information via cellular to a data center from which the study retrieves this information
- The data loggers transmit vehicle information every minute during vehicle operation
- Approximately $300 for 6 months per logger
  - Includes everything (cellular, etc.)

Step 2: Instrumentation Setup

Instrumentation plugs into the vehicle OBD-II port, standard on all vehicles as of January 1996 and takes approximately 1-2 min per vehicle.

- Visit the Install Video
  - http://www.intouchmvc.com/codriver-obd-install-doc.html

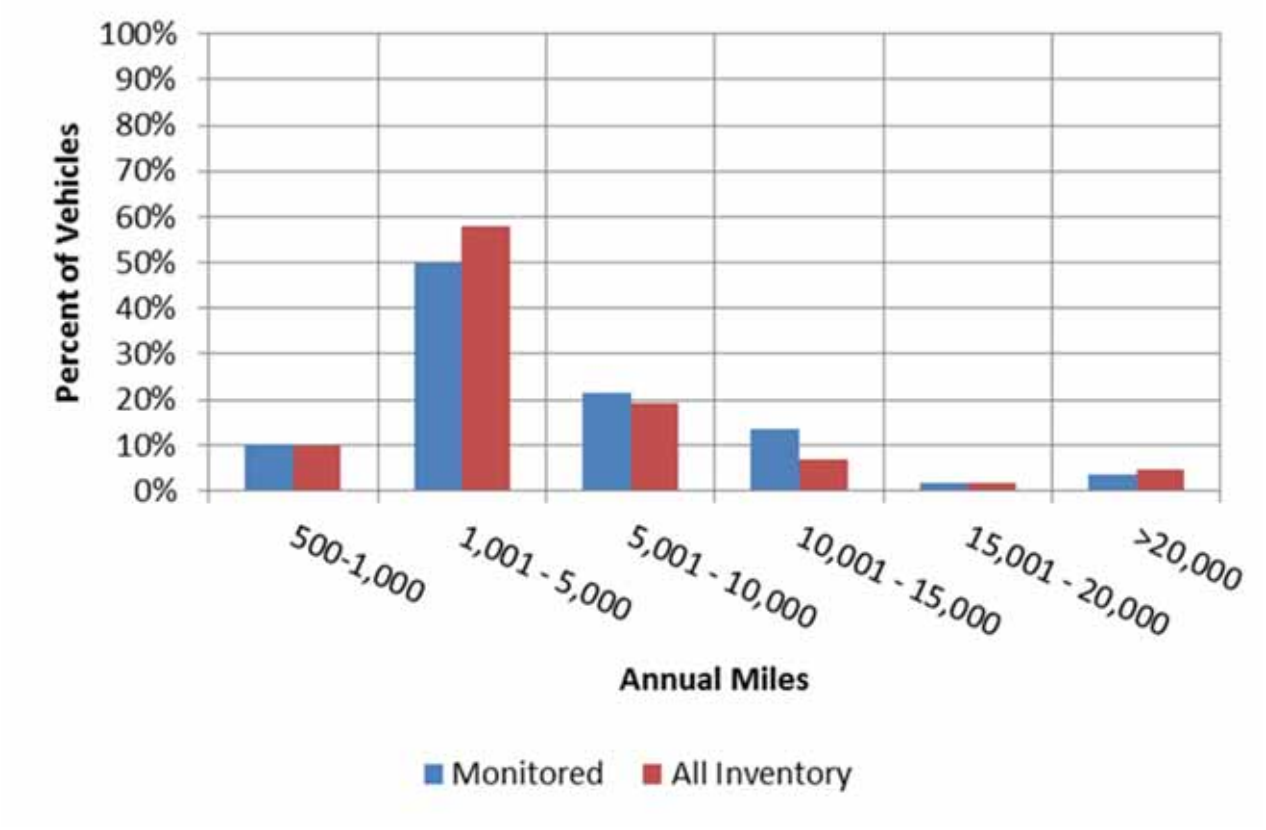
- Install Steps
  - Vehicle is in an open area
    - Must have clear view for GPS and Cellular Service
  - Plug into the Vehicle's Diagnostic Port
    - Normally found under the vehicles steering column, but varies by model.
  - Turn on the ignition
    - Red Light, Blue Light should be blinking
  - Record the Data Logger Number
    - Gold Number on end of data logger
    - Record to the Vehicle Information Sheet

Data Collected

- **Data consist of key-on events, key-off events, and position updates logged every minute while the vehicle is keyed-on**
- **TouchMVC fleet reporting converts these data points into records of trip events, stop events, and idle events**
- **From these data points, the following information will be available for evaluation:**
  - **Trip start and stop time and location**
  - **Trip distance and duration**
  - **Idle start time, location, and duration**
  - **Typical vehicle operating schedule**
- **The data loggers are retained on a vehicle for 6 to 8 weeks to gather sufficient movement information on the vehicle**
- **We did not need additional data rpm, speed, accessory loads, etc.**

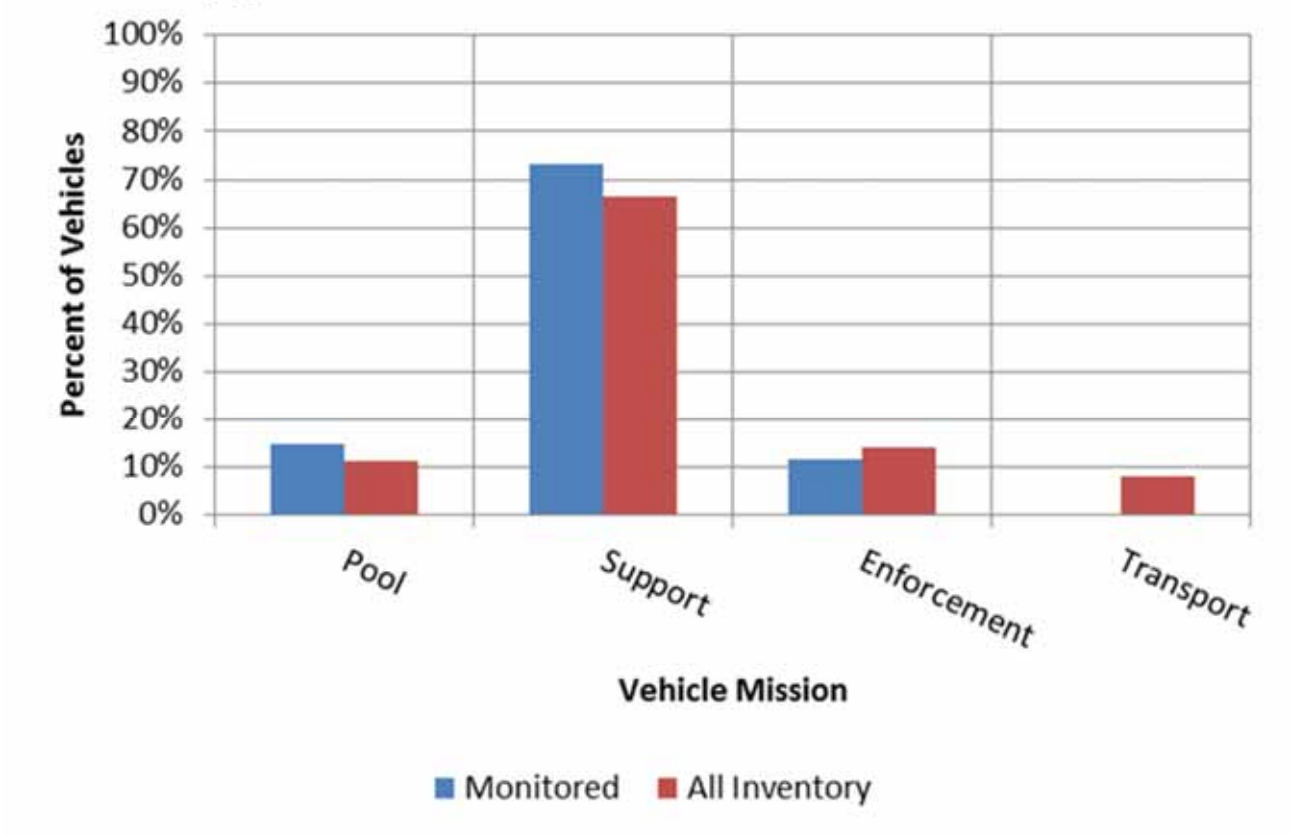
Background – DOE/DOD MOU

- **Annual mileage of the monitored vehicles compared to the full inventory of vehicles**
- **The characteristics of 60 monitored vehicles closely match the entire inventory**



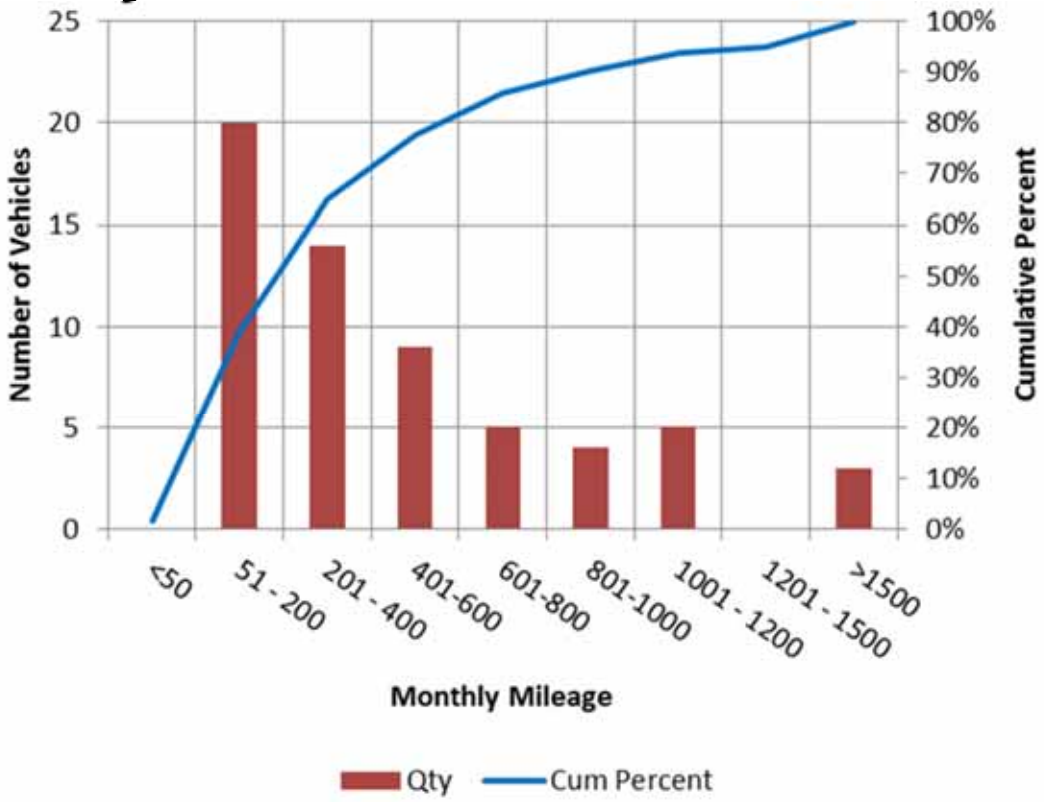
Background – DOE/DOD MOU

- **Mission of the 60 selected vehicles compared to the mission of the full inventory**
- **The "transport" mission is typically used for heavier-duty vehicles, while cargo vans and pickups are more typically used in a "support" mission**



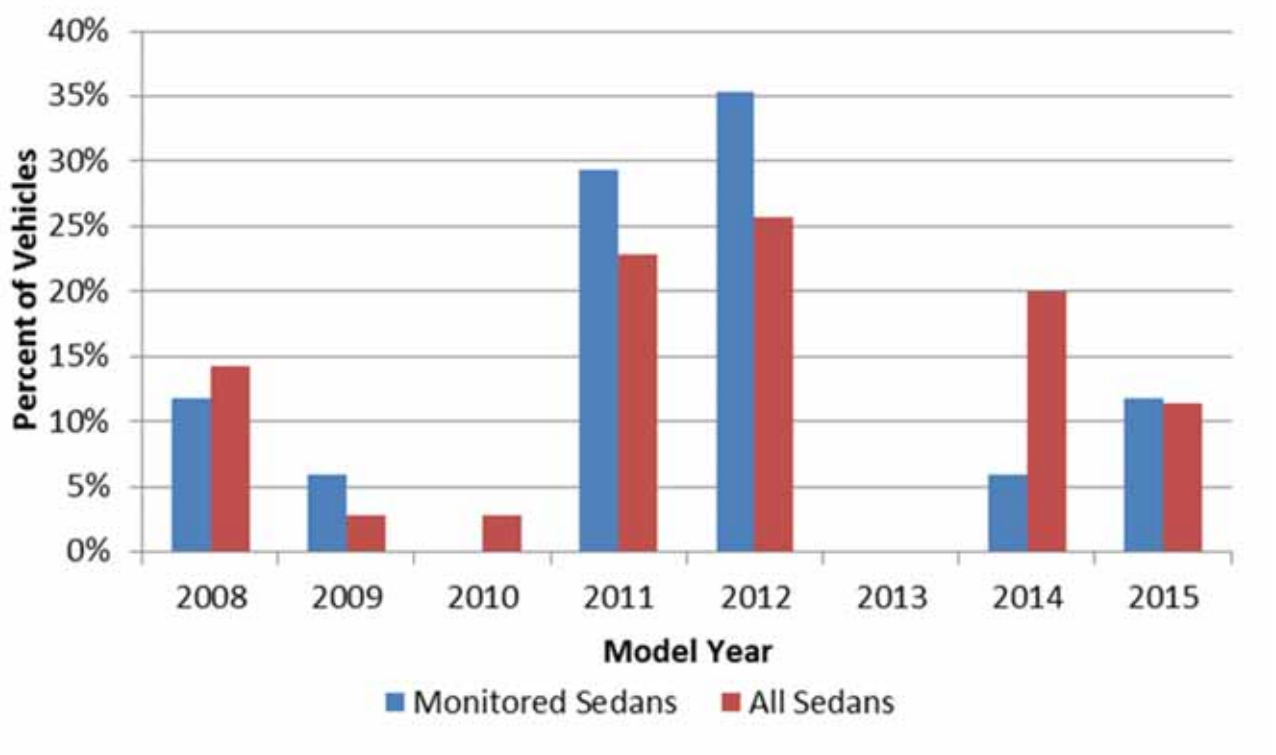
Monthly Mileage Distribution of Monitored Vehicles

- **Fully 95% of the 60 monitored vehicles average less than 1,500 miles per month in travel**
- **This is the same percentage as the entire fleet inventory**
- **A significant number of vehicles should be eligible for replacement by BEVs**

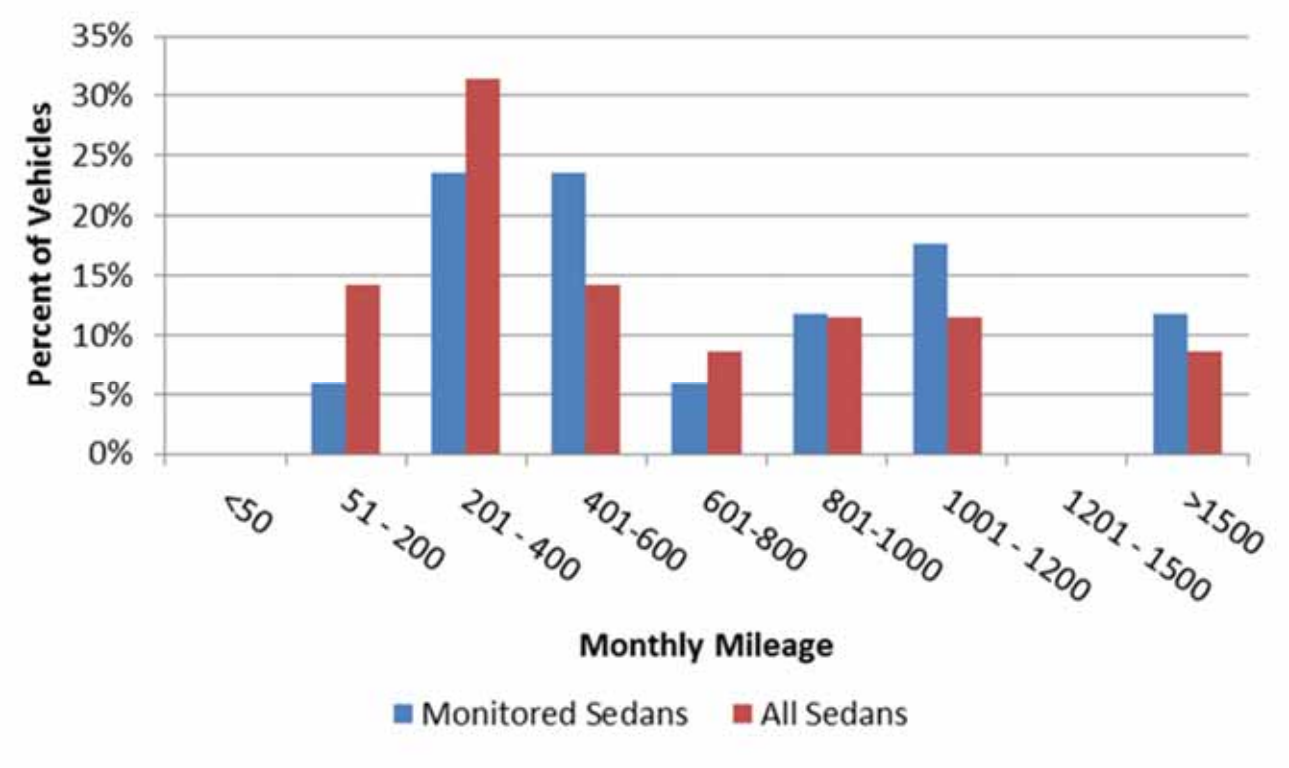


Model Year of Sedans

- **The 60 vehicles selected for monitoring are slightly older than the full inventory of sedans**



Sedans Monthly Mileage



Task 2 Summary

- **The 60-vehicle subset of the fleet inventory reflects the overall fleet inventory characteristics**
- **Data collection on these vehicles would commence and the results will be the focus of Task 3**
- **A close match of the monitored vehicles to the full fleet allows extrapolation of data on the 60-vehicle subset to the full fleet**

Task 3. Assessment of Charging Infrastructure for Plug-in Electric Vehicles at Naval Air Station Whidbey Island

Task 3. Objectives

- **Capture vehicle use data in the 60 vehicle sample**
- **Perform the data analysis related to replacing current vehicles with PEVs and charging infrastructure**
- **Make PEV replacement recommendations**
- **The infrastructure recommendations depend upon the type of PEV to be charged, time available for charging, locations of typical vehicle parking, fleet management attention, and electrical power availability**

PEV Recommendations

- 60 monitored vehicles replacement summary

	Sedan - Compact	Sedan - Midsize	Sedan- Large	Minivan	SUV	Van Cargo	Van Pass	Pickup	Total
ICE	-	-	-	-	-	-	-	-	0
BEV	2	3	0	7	1	2	5	12	32
PHEV	3	8	3	2	2	0	4	6	28
Total	5	11	3	9	3	2	9	18	60

- Assuming that the 175-vehicle fleet operates in a manner similar to the sample, the total fleet composition could consist of 92 BEVs, and 83 PHEVs

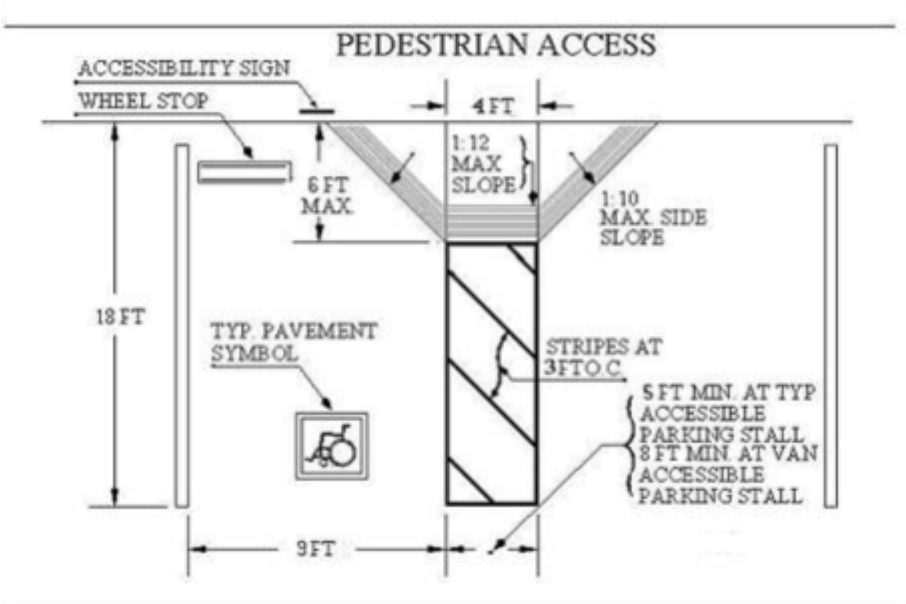
	Sedan - Compact	Sedan - Midsize	Sedan- Large	Minivan	SUV	Van Cargo	Van Pass	Pickup	Total
ICE	-	-	-	-	-	-	-	-	0
BEV	1	5	4	7	1	37	6	31	92
PHEV	4	15	6	4	12	17	13	12	83
Total	5	20	10	11	13	54	19	43	175

Infrastructure Installation Considerations

- **Proximity to power supply connections:**
  - **EVSE installation requires installing new dedicated branch circuits from the central meter distribution panel to EVSE**
  - **Proximity to the electrical service panel should be an important factor in locating this parking area**
  - **The length of the circuit run and the number of EVSE units will have a significant impact on the cost**
  - **Consideration should also be given to the potential for adding PEVs in the future**
  - **Installing additional conduit to feed future EVSE units reduces future costs**

Infrastructure Installation Considerations cont'd

- **ADA considerations:**
  - **The Americans with Disabilities Act provides requirements on accessibility for many situations but does not directly address PEV charging stations**
  - **While the exact requirements may not be applicable to military bases, compliance may present best practices**



Infrastructure Installation Considerations cont'd

- **Physical protection of the equipment:**
  - **Unless de-energized by the local disconnect, the EVSE is considered electrically energized equipment**
  - **Because it operates above 50 volts, Part 19 Electrical Safety of the Occupational Health and Safety Regulation requires guarding live parts**
  - **EVSE may be positioned in a way that requires a physical barrier for its protection**
  - **Frequently, wheel stops, curbs, or bollards are utilized to provide physical protection.**

Infrastructure Installation Considerations cont'd

- **Data Acquisition and Reporting:**
  - **It is likely that accounting for the electrical energy used for recharging vehicles will be required**
  - **Typically, the electrical energy supplied to a building is a facility cost but energy delivered to PEVs will be fuel costs**
  - **While the EVSE can be metered, the use of "smart" EVSE capable of data collection and transmittal can be very useful in identifying usage associated with specific vehicles and thus enhance fleet management**

Infrastructure Installation Considerations cont'd

- **Base Cyber Security:**
  - **Smart EVSE are likely to collect data locally in the EVSE or network of EVSE, and transmit via internet or cellular communications to an off-site data center**
  - **Transmittal of the data back to the DOD facility may create issues with cyber security for the facility**
  - **Local transmittal to the appropriate fleet manager could be a benefit**

GSA Installation Guide

- **The General Services Administration (GSA) provides information and guides related to PEVs**
- **The Installation Guide linked on their website provides specific installation instructions for the ChargePoint Networked Charging Station**
- **These instructions apply once all the other site conditions have been resolved and provide the detailed systematic instruction for installing a ChargePoint brand EVSE**

- http://gsa.gov/portal/mediaId/184507/fileName/Charging_Station_Installation_Guide.action

Electric Utility Demand Charges

- Puget Sound Energy provides the electrical supply
- PSE electric rate schedule 49 for commercial or industrial customers includes electrical supply demand charges
- The demand charge is billed at the highest measured demand for the month
- Not only is the energy (kWh) consumed billed to NASWI but the power (kW) delivered is also billed
- The power required by DCFC is usually up to 60 kW
- The Puget Sound Energy's demand charge for Schedule 49 is $3.70/kVa
- There is a cost impact for the power demand of both DCFC and AC Level 2 installed in clusters
- The impact of DCFC is up to 8 times that of AC Level 2 although the simultaneous operation of AC Level 2 can have the same impact

Analysis definitions:

- **Outing: An outing is the combination of trips and stops that begin at the home base and includes all travel until the vehicle returns home**
- **Trip: A trip begins with a key-on event and ends with the next key-off event**
- **Vehicle stop: A vehicle stop includes a key-off/key-on event pair**
- **Idle time: Idle time is the amount of time a vehicle spends stationary after a key-on event when the vehicle is not moving for a period of 3 minutes or longer**
- **Trip travel time: Trip travel time is the amount of time required to complete a trip, excluding stops but including idle time.**

Commands Group PEV Recommendations

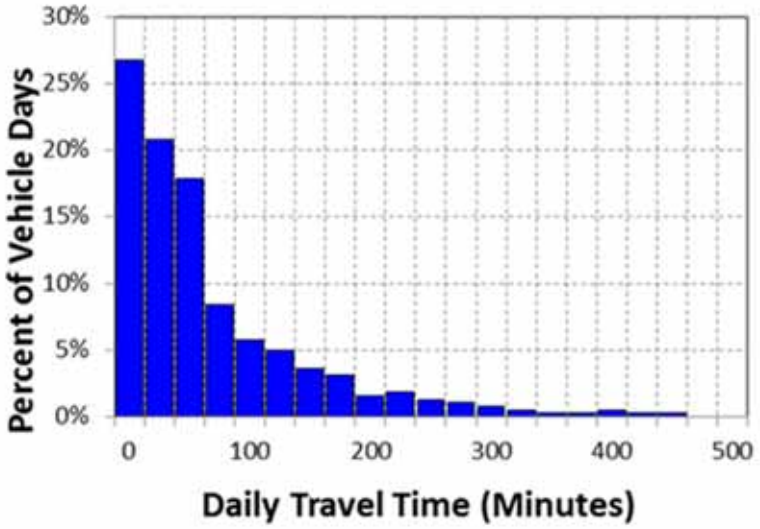
- Analysis permitted making PEV replacement recommendations for the monitored Vehicles

Vehicle Index					
Fleet Vehicle Id	Make	Model	EPA Class	Replacement PEV	Mission
G10-1138M	Chevrolet	Malibu	Sedan - Midsize	Ford Fusion	Support
G10-1140M	Chevrolet	Malibu	Sedan - Midsize	Nissan Leaf	Support
G10-3576L	Chevrolet	Malibu	Sedan - Midsize	Ford Fusion	Support
G10-7547F	Dodge	Avenger	Sedan – Midsize	Nissan Leaf	Support
G41-1136K	Dodge	Grd Caravan SE	Minivan	Nissan Leaf	Support
G41-1139K	Dodge	Grd Caravan SE	Minivan	Honda Fit	Support
G41-1140K	Dodge	Grd Caravan SE	Minivan	Honda Fit	Support
G41-1155K	Dodge	Grd Caravan SE	Minivan	Mitsubishi Outlander	Support
G41-1351G	Dodge	Dakota	Pickup	Toyota Rav4	Support
G41-2911M	Chevrolet	Colorado	Pickup	Via VTRUX PU	Support
G41-3153P	Dodge	Grd Caravan SE	Minivan	Honda Fit	Support
G41-3159P	Dodge	Grd Caravan SE	Minivan	Honda Fit	Support
G42-0587K	Chevrolet	Silverado	Pickup	Via VTRUX PU	Support
G42-0590K	Chevrolet	Silverado	Pickup	Nissan eNV200	Support
G42-1232M	Ford	F150	Pickup	Toyota Rav4	Support
G42-1281M	Ford	E-350	Van - Pass	Via VTRUX Van	Support
G43-3437B	Ford	E-350	Van - Cargo	Nissan eNV200	Support
G61-0513K	Ford	Explorer	SUV	Mitsubishi Outlander	Support

Commands Group PEV Profiles

Support Vehicles Travel Time Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Time (Minutes)	74.6/458.0	38.0/1043.0	264.0/455.5	30,308
Idle Time (Minutes)	13.3/NA	5.4/NA	1.7/NA	5,964

- The average daily usage is just over one hour per day
- The peak daily usage was 7.6 hours
- The peak outing time was higher because of overnight trips away from the home base
- 47% of daily travel time is of 20 minutes duration or less
- Commands vehicles were operated 45% of the study days at an average daily usage of 1.1 hours
- The vehicles are used on frequent days but average usage per day is quite low



Commands Group PEV Locations

- The home bases of the 18 Commands' vehicles were provided by NASWI and confirmed by the data loggers

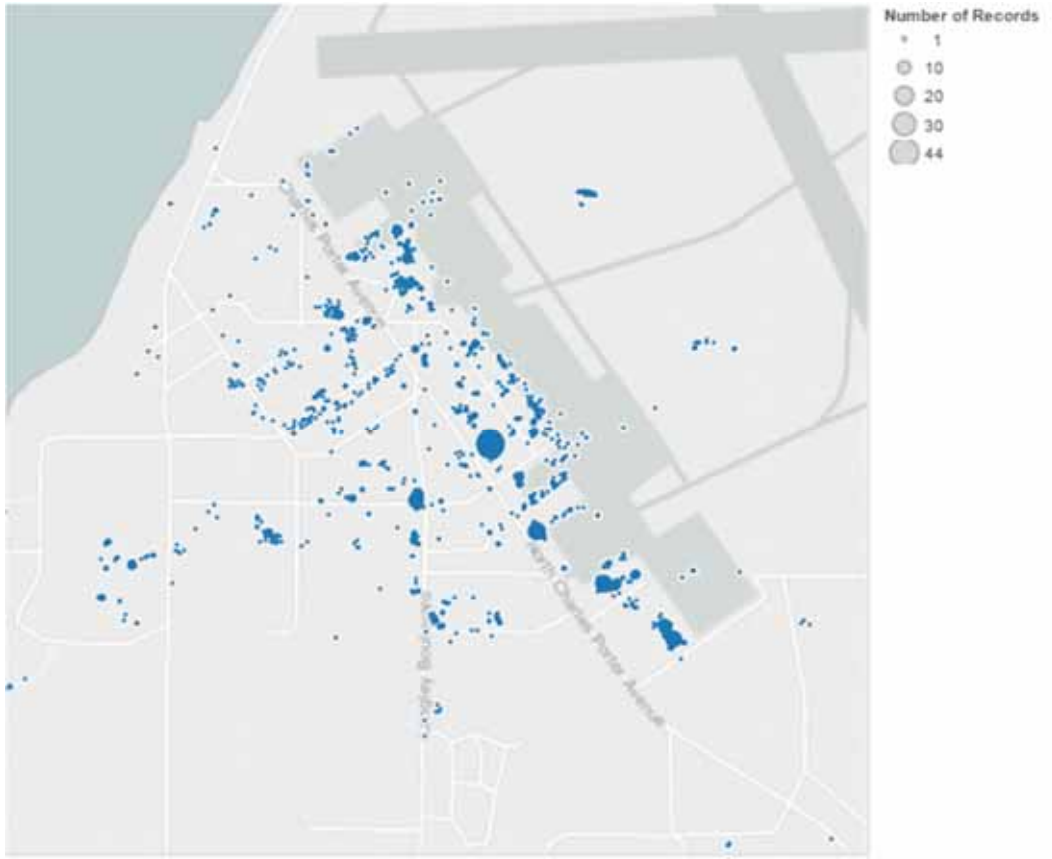
Logger ID	Fleet Vehicle Id	Replacement PEV	Home Base
4	G10-1138M	Rav4	Bldg 385, Lexington St
7	G10-1140M	eNV200	Bldg 2593, Orion St
16	G10-3576L	Rav4	Bldg 993, Hospital, Franklin St
19	G10-7547F	eNV200	Bldg 386, Charles Porter Ave
38	G41-1136K	Rav4	Bldg 2547, Essex Rd
40	G41-1139K	VTRUX PU	Bldg 410, Charles Porter Ave
41	G41-1140K	eNV200	Bldg 410, Charles Porter Ave
43	G41-1155K	eNV200	Bldg 993, Hospital, Franklin St
47	G41-1351G	VTRUX PU	Bldg 2544, Prowler St
74	G41-2911M	VTRUX PU	Bldg 975, Midway St
75	G41-3153P	VTRUX PU	Bldg 385, Charles Porter Ave
76	G41-3159P	eNV200	Bldg 976, Princeton St
80	G42-0587K	eNV200	No Data (Bldg 410)*
82	G42-0590K	VTRUX PU	Bldg 385, Charles Porter Ave
90	G42-1232M	eNV200	Bldg 2737, Lexington St
91	G42-1281M	Rav4	Bldg 2737, Lexington St
100	G43-3437B	Rav4	Bldg 2642, Essex Rd
103	G61-0513K	VTRUX Van	Bldg 2897, Ranger St

Commands Group PEV Locations

- **Overview of home base locations**

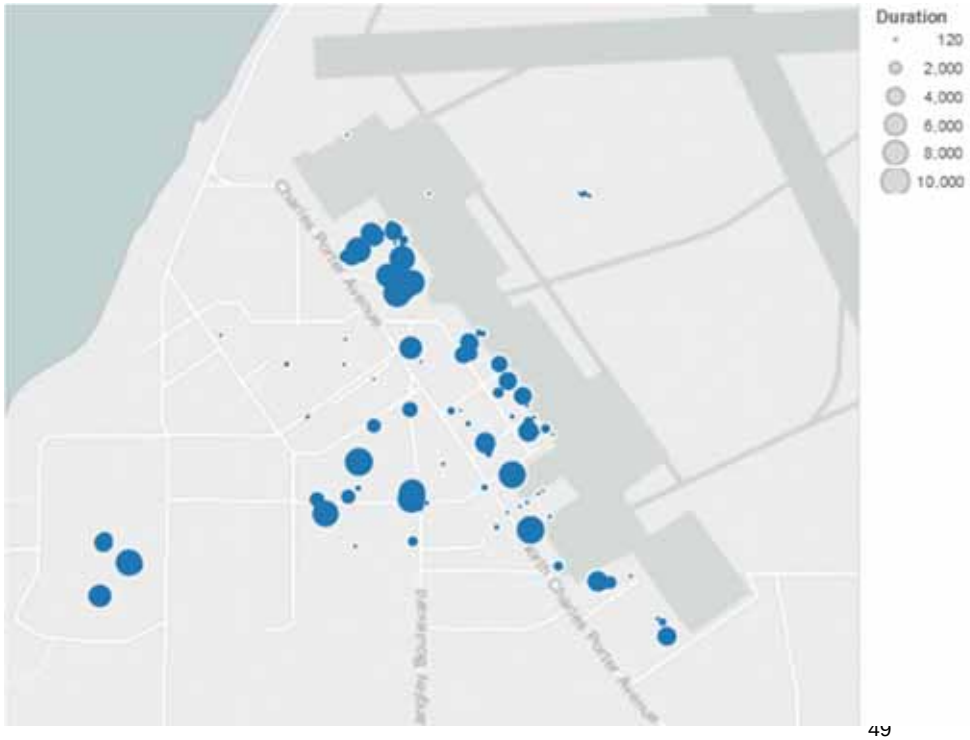
Commands Group PEV Parking

- The vehicles for the Commands Group typically park overnight at their home base
- PEVs benefit from additional charge opportunities if EVSE are located in areas where they frequently stop



Commands Group PEV Dwell Times

- The number of times a vehicle parks in a location is of little value in determining where to place EVSE
- The length of time a vehicle is parked at a particular location is of more value as some recharge may occur
- Below are the locations where Commands vehicles parked for more than 2 hours during the day
- The locations identified are home base locations



Commands Group PEV Recommendations

- **Data show that the recommended PEVs should have sufficient time daily for recharging at the home base**
- **The infrequent possibility of the away-from-home base parking suggests that such charging would not be of much benefit**
- **Home base charging only is suggested as most of the Commands vehicles are parked in unique locations**
- **11 BEVs and 7 PHEV are recommended**
- **11 AC Level 2 and 7 AC Level 1 EVSE are recommended**

Commands Group PEV Recommendations cont'd

- Connecting the vehicles overnight should provide sufficient recharge time for all vehicles
- For sites needing a single EVSE, the preparations should be made for a second unit without actually installing it
- Allows a second unit to be installed later when the demand for that unit occurs

Bldg	Vehicles Assigned	BEVs Recommended	PHEVs Recommended	AC L2 EVSE	AC L1 EVSE
385	3	2	1	2	1
386	1	1	-	1	-
410	3	2	1	2	1
975	1	-	1	-	1
976	1	1	-	1	-
993	2	-	2	-	2
2544	1	1	-	1	-
2547	1	1	-	1	-
2593	1	1	-	1	-
2642	1	1	-	1	-
2737	2	1	1	1	1
2897	1	-	1	-	1
Total	18	11	7	11	7

Commands Group Full Compliment of Vehicles Recommendations

- **For the full compliment of 69 support vehicles in the Command Group, 42 BEVs, and 27 PHEVs conservatively meets vehicle travel requirements**
- **28 AC Level 2 and 18 AC Level 1 EVSE could provide the necessary recharge capabilities with management attention to ensure all vehicles are rotated on the equipment and receive their recharge**
- **It is surmised that many of these vehicles will be assigned to the buildings identified above and that the PEVs can share the charging times at the EVSE**

Entire Monitored Fleet - Recommendations

Aggregated Vehicles Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Time (Minutes)	112.2/1,232.0	38.8/1,202.0	15.5/14,367.0	155,396
Idle Time (Minutes)	34.8/NA	12.0/NA	4.8/NA	48,215

- **The average daily usage for all vehicles is just under two hours per day**
- **The longest daily travel was an enforcement vehicle usage of about 20.5 hours**
- **32 BEV and 28 PHEVs would meet current mission requirements**
- **29 AC Level 2 and 22 AC Level 1 EVSE ports should be sufficient for recharging**

Entire NASWI Fleet - Recommendations

- **With 175 vehicles in the Fleet, 92 BEVs and 83 PHEVs should meet mission objectives**
- **Because the utilization of these vehicles is low, 70 AC Level 2 and 58 AC Level 1 EVSE should meet recharging requirements**
- **Some management attention will be required to insure that the vehicles are effectively rotated on the AC Level 2 EVSE for charging and dispatched based upon the battery state of charge**
- **It is likely that such attention is already employed when assigning pool vehicles**
- **Connecting the vehicles overnight should provide sufficient recharge time for all vehicles**

EVSE Recommended Locations Overview

- **The availability of electrical power near the desired EVSE location is the most important factor affecting installation costs**
- **Locations nearer the electrical supply will result in shorter conduit and conductor runs to minimize costs**
- **Locations near landscaped areas reduce costs by reducing the amount of asphalt or concrete cuts to install the conduit**
- **At the same time, the location for the fleet vehicles should not be in the most ideal of parking locations for the facility if they are to be restricted for PEV charging only since the EVSE are not likely to be available to POVs and other non-fleet vehicles**

EVSE Recommended Locations Overview cont'd

- The parking areas near the buildings will produce the least distance from the power center
- However, for some buildings that will be destinations for publically owned vehicles and business other than the fleet vehicles, so site selection may not be the closest building approach

- Major substations related to the electrical distribution were provided to the study, but this is insufficient for detailed EVSE planning, as the EVSE location is specific to home base buildings
- Potential EVSE locations identified are based upon apparent distances from buildings, available information on electrical sources, and ease of installation
- Google Earth provides the pictorial maps

EVSE Per Building Recommended Locations

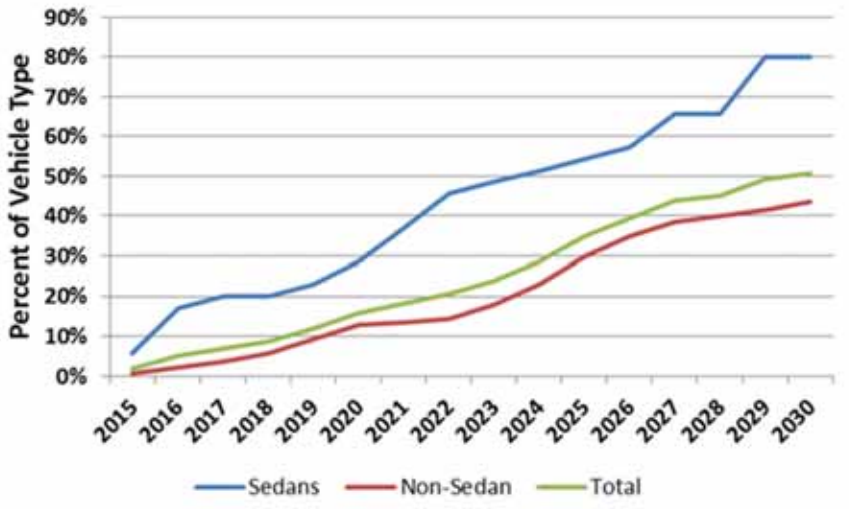
Task 3. Summary

- Whidey's vehicle replacement schedule would dictate the charging infrastructure deployment schedule
- Vehicle and EVSE schedules can factor into budget considerations for implementing vehicle replacements
- Vehicle and EVSE schedules can factor into base objectives in fuel cost reductions and GHG emissions reductions
- The analysis shows the average vehicle travels approximately 5,090 miles per year. This is an average of less than 100 miles per week. This was a consideration to reduce the number of AC Level 2 EVSE and thus reduce EVSE costs

Task 4. Implementation Approach for Electric Vehicles at Naval Air Station Whidbey Island

Task 4. Objective

- **Develop a replacement approach for the adoption of PEVs**
  - **Focuses on an implementation plan for PEV adoption**
  - **Provide a gradual introduction of PEVs into the operations of the non-tactical fleet which provides a transitional period to allow greater experience in the operation, maintenance, and support of PEVs**
  - **PEVs introduced would provide for 51% of the fleet by 2030 assuming the size of the fleet remains as it was in 2015**



GSA Vehicle Replacement Requirements

- **Note that both the age and mileage requirements need to be met in order for the vehicle to qualify for replacement, except where noted as "or"**

GSA Vehicle Replacement Requirements			
	Fuel Type	Years	Miles
Passenger vehicles	Gasoline or alternative fuel vehicle	3 4 5 Any age	36,000 24,000 Any mileage 75,000
	Hybrid	5	Any mileage
	Low-speed BEV	6	Any mileage
Light trucks 4 x 2	Non-diesel	7 or	65,000
	Diesel	8 or	150,000
	Hybrid	7	Any mileage
Light trucks 4 x 4	Non-diesel	7 or	60,000
	Diesel	8 or	150,000
	Hybrid	7	Any mileage
Medium trucks	Non-diesel	10 or	100,000
	Diesel	10 or	150,000
Heavy Trucks	Non-diesel	12 or	100,000
	Diesel	12 or	250,000

GSA Vehicle Replacement Requirements

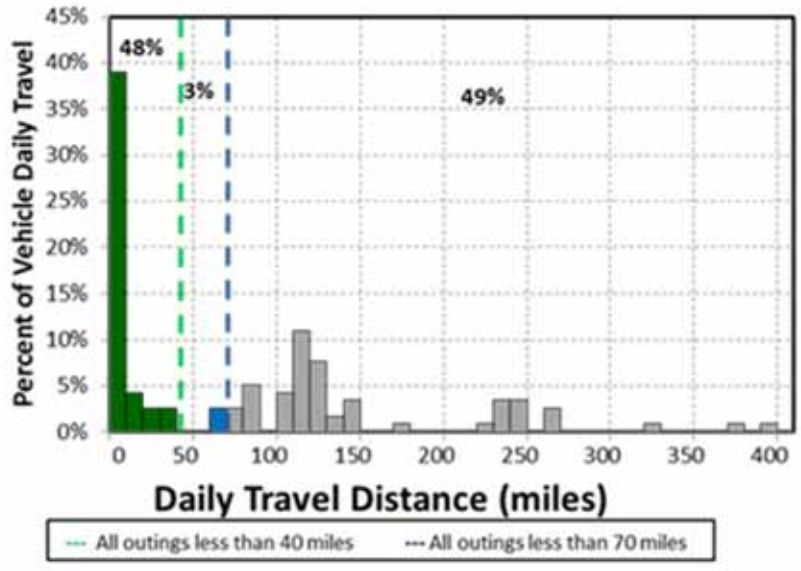
- As GSA increases its certification of PHEVs and BEVs, agencies can plan for vehicle replacement through GSA for passenger vehicles and light-trucks
- GSA provides a summary of light- and medium-duty passenger vehicles available for lease or purchase through the GSA portal , although not all BEVs and PHEVs currently on the market are ‘certified’ to be GSA replacements
- Vehicles not on the GSA list of ‘certified’ vehicles require an agency to self-certify a functional need or alternative measures for exemptions

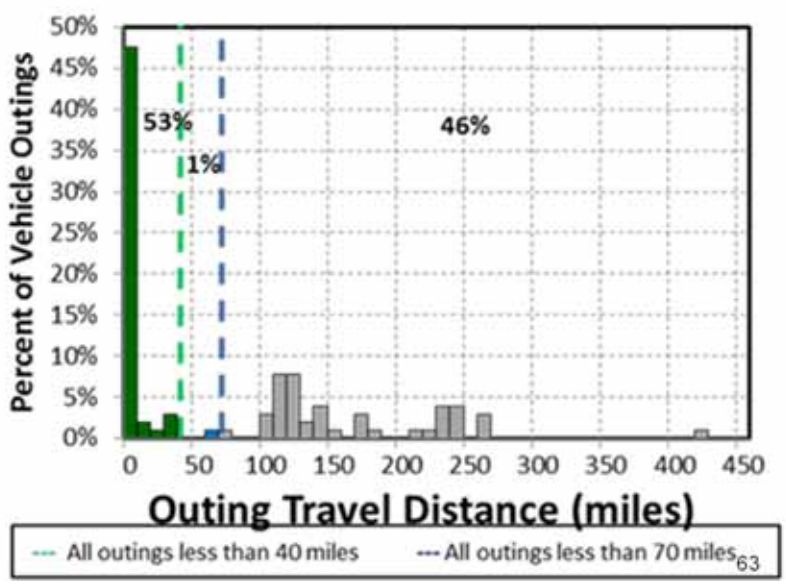
Pool Missions

- Travel Summary for the 9 vehicles monitored
- 9,525 miles, logged 247 hours, and idled for 21 hours

Pool Vehicles Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	80.8/396.6	92.5/1008.4	16.8/162.1	9,525
Travel Time (Minutes)	125.4/486.0	143.7/1202.0	26.2/237.0	14,802
Idle Time (Minutes)	10.6/NA	12.2/NA	2.2/NA	1,255

- Green and blue bars are BEV safe miles



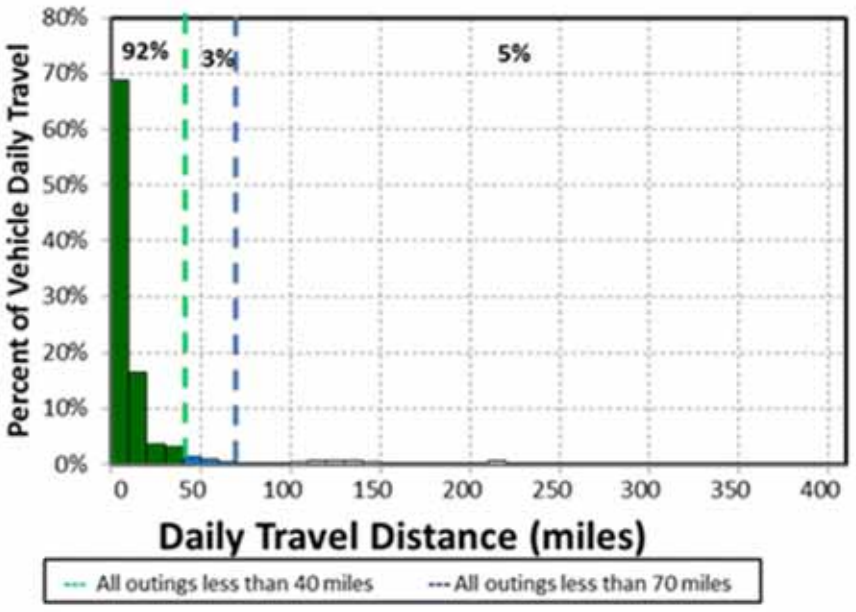


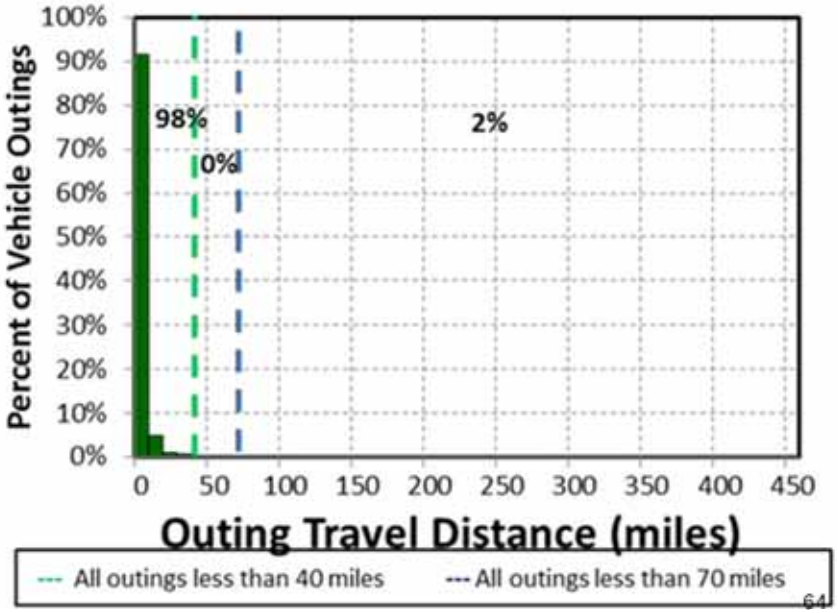
Support Missions

- **Travel Summary for the 44 vehicles monitored**
- **16,766 miles, logged 1021 hours, and idled for 256 hours**

Support Vehicles Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	16.6/379.7	5.6/1008.4	2.6/228.1	16,766
Travel Time (Minutes)	60.5/458.0	20.6/1043.0	9.6/264.0	61,279
Idle Time (Minutes)	15.2/NA	5.2/NA	2.4/NA	15,390

- **Green and blue bars are BEV safe miles**



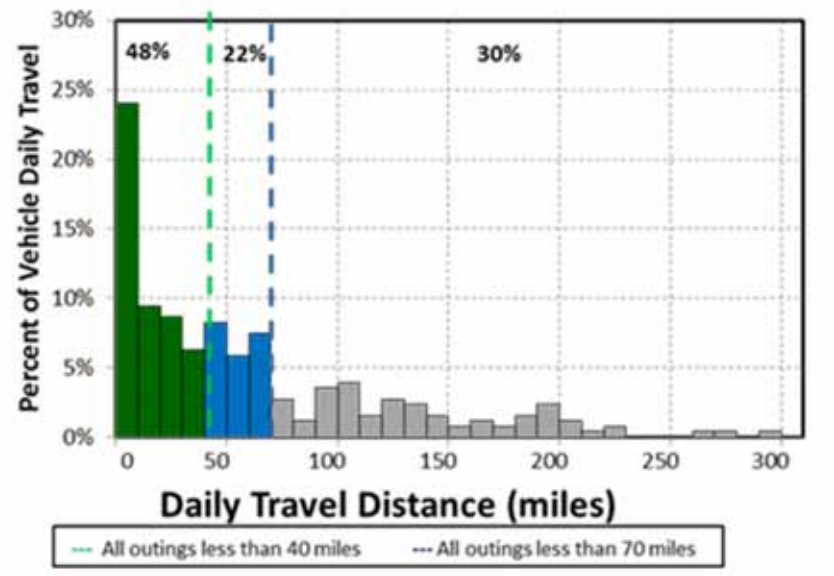


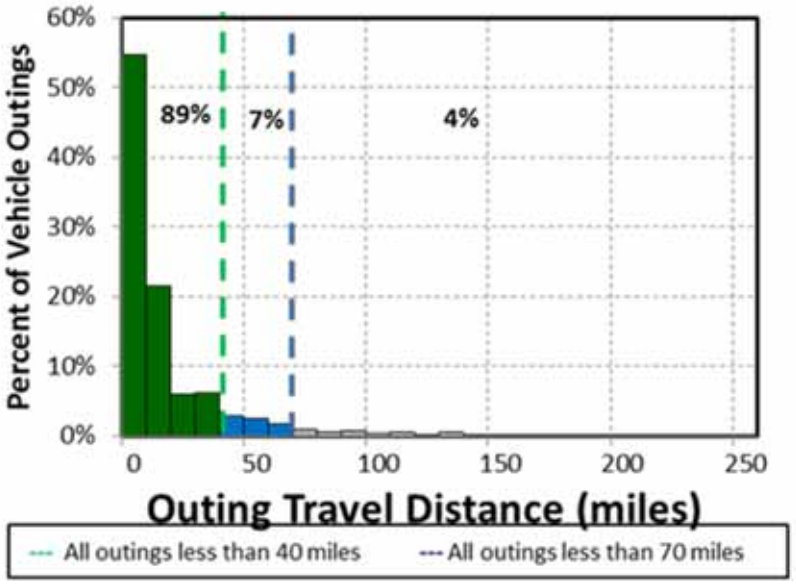
Enforcement Mission

- **Travel Summary for the 7 vehicles monitored**
- **15,219 miles, logged 1,322 hours, and idled for 526 hours.**

Enforcement Vehicles Travel Summary				
	Per Day Average/Peak	Per Outing Average/Peak	Per Trip Average/Peak	Total
Travel Distance (Miles)	60.2/294.5	16.5/232.5	4.9/86.7	15,219
Travel Time (Minutes)	313.5/1232.0	86.0/1072.0	25.5/555.0	79,315
Idle Time (Minutes)	124.8/NA	34.2/NA	10.2/NA	31,570

- **Green and blue bars are BEV safe miles**





Replacement Approach

- **Full fleet replacement projections based upon GSA replacement criteria**
- **Replace selected ICE vehicles with PEVs as they would normally be replaced**

Year	Sedan - Compact	Sedan - Midsize	Sedan- Large	Minivan	SUV	Cargo Van	Pass. Van	Pickup	Total
2015	-	-	3	-	6	4	-	8	21
2016	1	5	-	1	-	1	-	-	8
2017	-	2	-	1	1	2	-	-	6
2018	-	-	-	-	-	2	2	-	4
2019	1	-	-	-	1	2	2	1	7
2020	1	1	-	1	1	2	3	1	10
2021	1	2	-	2	2	1	2	-	10
2022	1	3	-	-	1	2	-	-	7
2023	1	-	-	-	-	1	-	5	7
2024	-	1	-	-	-	1	4	4	10
2025	-	-	1	3	-	8	-	12	24
2026	-	1	1	1	-	8	-	5	16
2027	-	4	-	-	1	6	2	4	17
2028	-	-	-	-	-	9	2	-	11
2029	-	-	5	2	-	-	-	1	8
2030	-	-	-	-	-	6	2	1	9
Total	6	19	10	11	13	55	19	42	175

Replacement Approach cont'd

- **The initial focus was on sedans because they are the easiest to incorporate into the various missions and because these were the only types listed on the GSA schedule when the study was conducted**
- **Some of the remaining vehicle types are included to gain initial experience with the vehicle types although not listed on the GSA schedule**

Replacement Approach cont'd

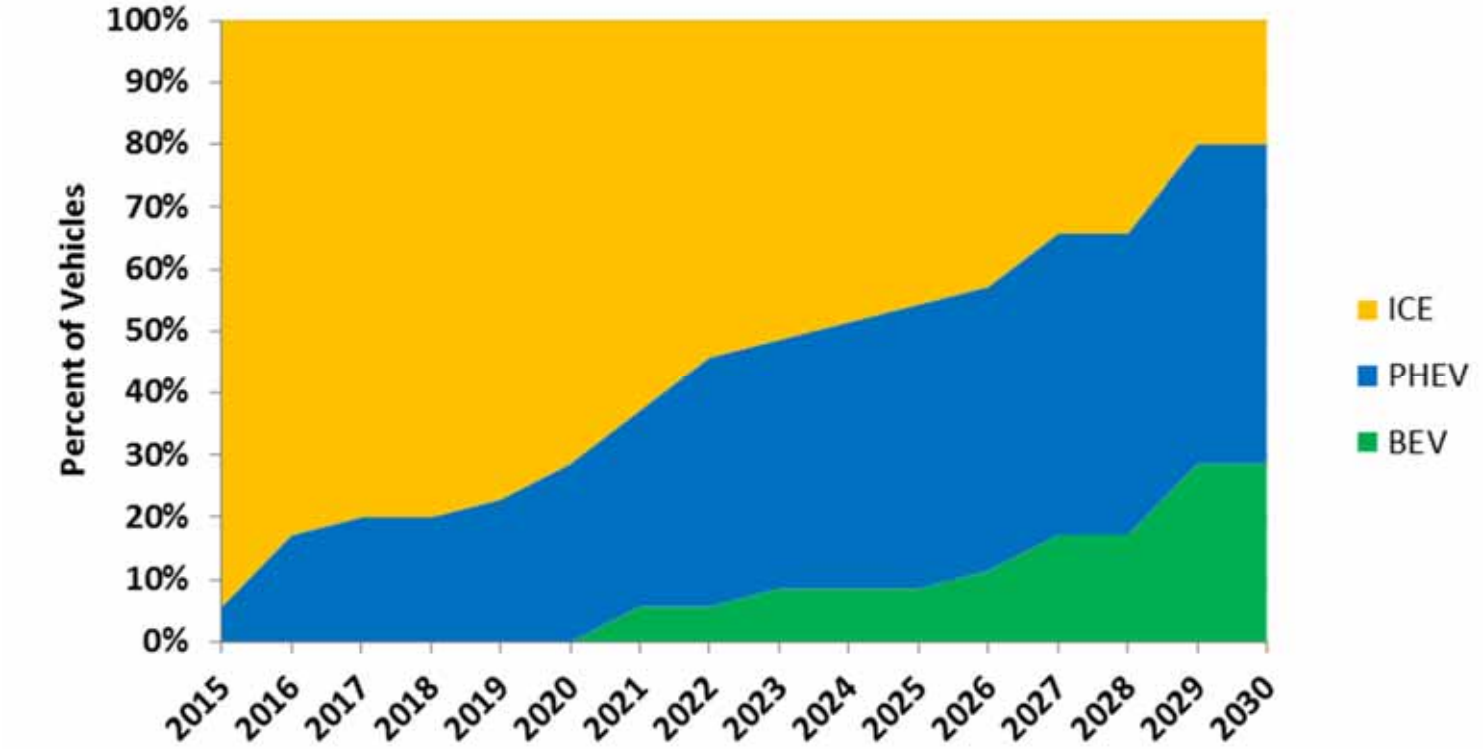
- **It was desirable to select a BEV if the body type and capabilities meet the vehicle's mission**
  - **Gains the most benefit in fuel cost and GHG emission reduction**
- **In most cases, the greatest component of a particular fleet could be BEVs**
- **The analysis in Task 3 showed the average vehicle travels less than 5,090 miles per year**
- **This is an average of 424 miles per month or just under 100 miles per week**
- **This also reflects the opportunity to increase the percentage of BEVs over PHEVs**

Replacement Approach for Sedans

- At the end of the 16 year period, 80% of fleet sedans will be PEVs with 36% BEVs and 64% PHEVs

Year	ICE	PHEV	BEV	Total PEVs	Vehicles Replaced	Percentage PEV/Year	Cumulative Percent PEV
2015	1	2	-	2	3	67%	67%
2016	2	4	-	4	6	67%	67%
2017	1	1	-	1	2	50%	64%
2018	-	-	-	-	-	-	64%
2019	-	1	-	1	1	100%	67%
2020	-	2	-	2	2	100%	71%
2021	-	1	2	3	3	100%	76%
2022	1	3	-	3	4	75%	76%
2023	-	-	1	1	1	100%	77%
2024	-	1	-	1	1	100%	78%
2025	-	1	-	1	1	100%	79%
2026	1	-	1	1	2	100%	77%
2027	1	1	2	3	4	75%	77%
2028	-	-	-	-	-	-	77%
2029	-	1	4	5	5	100%	80%
2030	-	-	-	-	-	-	80%
Total	7	18	10	28	35		

Fleet composition for the years 2015 through 2030



Charging Infrastructure for Sedans

- **Projected schedule for the introduction of EVSE to support the sedan replacement approach**

	Commands Group	Department Group	Total
Year	AC L2/AC L1	AC L2/AC L1	ACL2/ACL1
2015	-	2 / -	2 / -
2016	-	4 / -	4 / -
2017	-	- / 1	- / 1
2018	-	-	-
2019	-	- / 1	- / 1
2020	-	- / 2	- / 2
2021	-	2 / 1	2 / 1
2022	3 / -	-	3 / -
2023	1 / -	-	1 / -
2024	-	- / 1	- / 1
2025	- / 1	-	- / 1
2026	-	1 / -	1 / -
2027	-	1 / 1	1 / 1
2028	- / 1	-	- / 1
2029	-	4 / 1	4 / 1
2030	-	-	-
Total	4 / 2	14 / 8	18 / 10

Charging Infrastructure for Sedans cont'd

- **AC Level 2 infrastructure is emphasized in the early adoption years over AC Level 1**
- **Typically, the EVSE are installed as dual units to reduce installation costs**
- **Because many facilities host a single PEV, the installation should at least include the stub-in of a second unit**

NASWI Study Summary

- **Based on the Micro-Climate study, NASWI is poised for the successful introduction of PEVs into daily operations**
- **BEVs can support most of the vehicle missions while providing savings in fuel costs and GHG emissions**
- **The adoption approach presents an opportunity to gain experience in the operation, support, and maintenance of PEVs**
- **NASWI may wish to move forward in the near future with the replacement of pool, support, and enforcement vehicles with PEVs as budget considerations allow**
- **The vehicle types studied may be candidates for immediate replacement**