Session 9: Marine Fleet Characterization Study

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Background

- INL was provided telematics sourced vehicle data for subset of four Marine fleets:
    - Marine Corps Logistics Base (MCLB) Barstow
    - Marine Corps Base (MCB) Camp Pendleton
    - Marine Corps Air Station (MCAS) Miramar
    - Marine Corps Air Ground Combat Center (MCAGCC) 29 Palms
- Data was evaluated data to support the introduction and use of battery electric vehicles (BEV)
- Individual observations of the existing internal combustion engine vehicles (ICEV) provide the basis for recommendations related to BEV adoption
- The total number of ICEVs in each fleet was not known by INL

Objective and Tasks

- The analysis consisted of four tasks:
  1. **Data was collected by the fleet manager via the fleet management tool**, Networkfleet®, and sent to INL
     - Consisted of an activity detail report and the stop detail reports, which included vehicle trip data
  2. Data collected by data loggers and fleet vehicle characteristics to describe typical fleet activity was **examined for completeness**
  3. Provide feedback to fleet personnel **on selection criteria** for replacement by BEVs in their specific fleet vehicle missions
  4. **Recommendations in the form of actionable information** to introduce BEVs into fleet operations

Data Available

- **Data consisted of key-on events, key-off events, and location, which were logged approximately every 2 minutes while the ICEV was running**
- **The ICEVs' daily usage was determined, with the following information available from the data:**
  - **Trip start and stop time and location**
  - **Trip distance and duration**
  - **Idle start time, location, and duration**
  - **Stop start time, location, and duration**
  - **Dates**

- **Trip distances were combined to enable analysis based on daily miles driven**

- **INL received no information related to the vehicle operator and provided no raw data to fleet managers**

Event Definitions

- **Definitions of these terms:**
  - **Trip**: A trip begin with a key-on event and ended with the next key-off event
  - **Parking event**: A vehicle parking event included the time between the key-off of the previous trip to the key-on of the next trip
  - **Idle time**: Idle time was the amount of time a vehicle was stationary after a key-on event when the vehicle was not moving for a period of 3 minutes or longer
  - **Trip travel time**: Trip travel time was the amount of time between key-on and the next key-off event

- **Data collection period for this analysis was 8/1/14 – 6/1/15**

Fleet Vehicle Selection

- **Fleet managers selected 73 ICEVs and provided basic information for each vehicle, including:**
    - **Managing base,**
    - **Primary vehicle mission,**
    - **Vehicle make, model, and model year**

Vehicle Mission	Study Vehicles
MCLB Barstow	5
MCB Camp Pendleton	53
MCAS Miramar	14
MCAGCC 29 Palms	1

- **Fleet managers assessed the wide range of vehicles and made selections of high-interest, representative vehicles based on vehicle missions and vehicle type/class**

BEV Range Estimates

- In order to determine if existing ICE vehicles in the fleets can be replaced by BEVs, the likely range of BEVs being offered during model year 2015 was established
- The Model Year 2015 Fuel Economy Guide (https://www.fueleconomy.gov/feg/pdfs/guides/FEG2015.pdf) lists BEVs the U.S. Navy might procure with ranges from 82 miles (Chevrolet Spark EV) to 93 miles (Kia Soul Electric)
- **INL could only guess on which BEVs will be offered and selected. This is NOT a recommendation**
- A mid-point of 87.5 miles per charge was assumed
- Note that these ranges were established without the real-world use of accessory loads (e.g., cabin comfort) that drivers demand
- It is also known that battery range is reduced over time

BEV Range Estimates – cont'd

- **A 15% reduction for accessory use and a 15% reduction at 5 years was assumed**
- **BEV range at end-of-life, not BEV range at beginning-of-life was used for analysis**
- **The below ranges of 59, 63 and 67 miles was used to estimate BEV range after approximately 5 years of use**

Model	Fuel Economy Guide Range	Estimated Range with Accessories (15% Reduction)	Estimated Range at 5 Years (15% Reduction)
Chevrolet Spark	82	69.7	59
Midpoint	87.5	74.4	63
Kia Soul	93	79.05	67

BEV Range Estimates Background

- **Testing of BEVs established that one test is not representative of the range every driver in every section of the United States will achieve**
- **As an example, testing of the 2013 Ford Focus demonstrated energy efficiencies of 149.9 to 479.1 Wh/mile (6.7 to 2.1 kW/ mile) (http://avt.inel.gov/pdf/fsev/fact2013fordfocus.pdf). The variation is due to different temperatures and speeds**
- **Nissan Leafs (with between 45,000 and 55,000 miles) operating in Los Angeles and San Diego were examined for 1,645 trips. They had an average range of 64.9 miles**
- **The Marine Corps fleet vehicles data suggested they averaged between 45,000 and 55,000 miles at 5 years**
- **Real world range adjustments seem reasonable**

Vehicle Descriptions & Data Validity

Fleet	Sedan Midsize	SUV	Mini-van	Van Cargo	Van Pass	Truck	Total
MCLB Barstow	1	—	1	—	1	2	5
MCB Camp Pendleton	14	—	7	—	12	20	53
MCAS Miramar	3	—	4	—	2	5	14
MCAGCC 29 Palms	1	—	—	—	—	—	1
Total	19	—	12	—	15	27	73

Vehicle Mission	Study Vehicles	Total Reported	Percentage of Sample Studied	Percentage of Total Fleet Size
MCLB Barstow	5	4	80.0%	?
MCB Camp Pendleton	53	50	94.3%	?
MCAS Miramar	14	13	92.9%	?
MCAGCC 29 Palms	1	1	100.0%	?

MCLB Barstow Vehicle Analysis Summary

Analysis Summary – 4 Vehicles	
Total Distance (miles)	22,959.2
Total Drive Time (hours)	1,277
Daily Average Trip Distance (miles)	36.0
Percent of Days Driven	49%

MCLB Barstow Vehicle Analysis Evaluation

- **Each set of Low, Med and High bars represent one existing fleet vehicle and how many days each year it would exceed the three BEV range scenarios. Graph represents four studied vehicles**

MCLB Barstow - Days Vehices Exceed Range
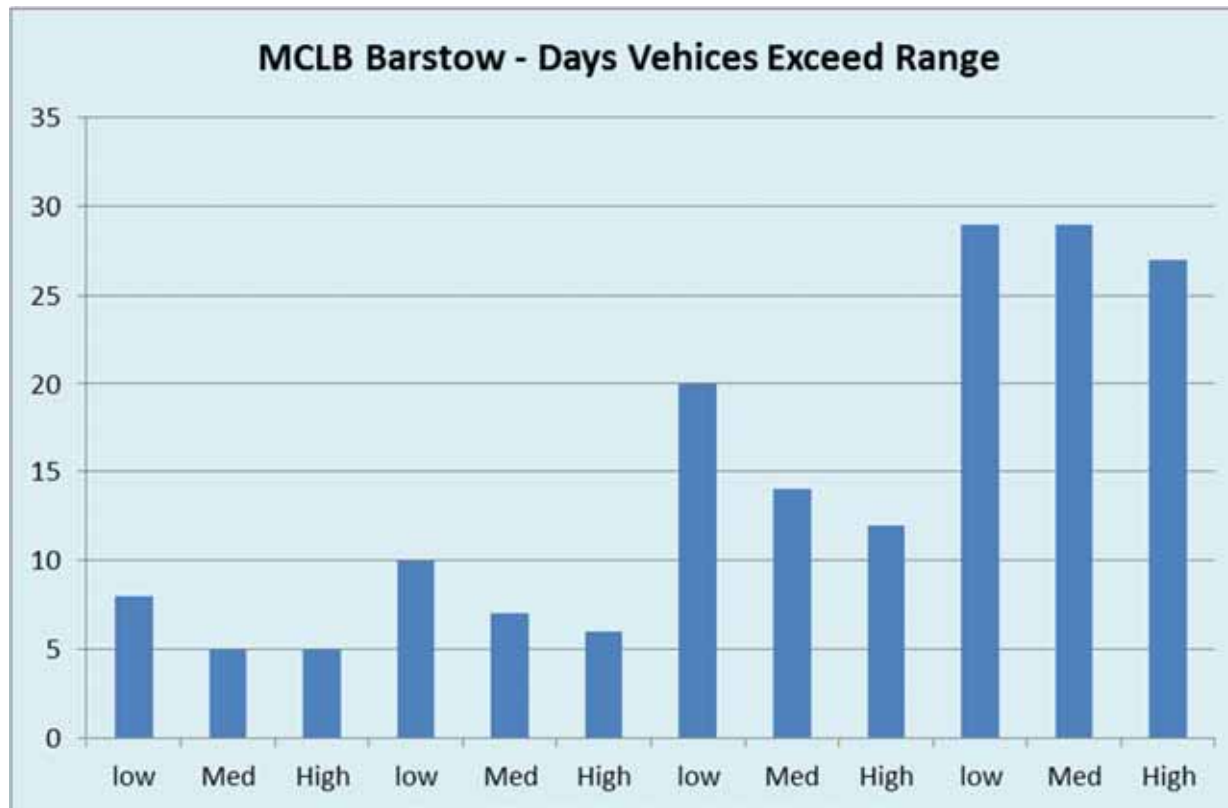
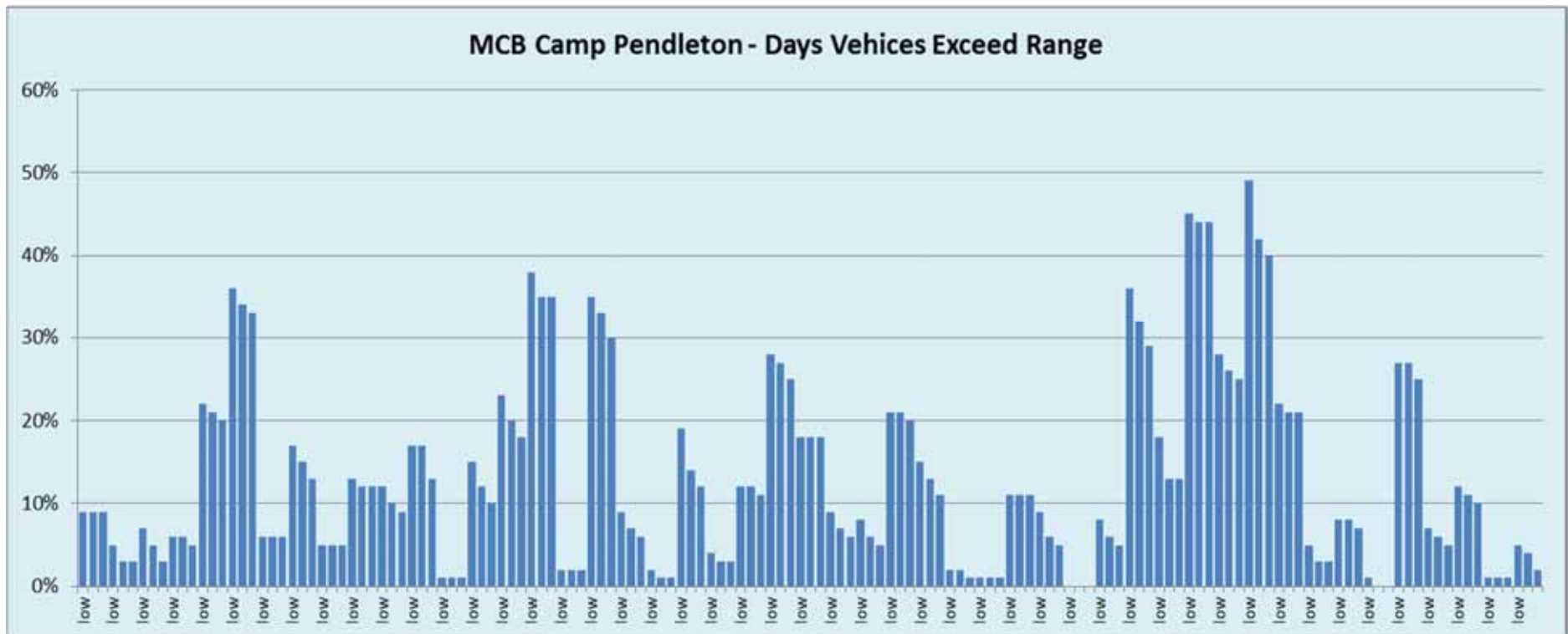# *MCLB Barstow Analysis Recommendations*

- **For all four Barston ICEVs, the recommendation was:**
  - **May be replaced with a BEV, provided that another vehicle is available for the long-range driving this vehicle occasionally supported. Charging can be accomplished overnight or on days when the vehicle is not driven**
- **The first two vehicles to the left of the graph are the best candidates for BEV replacement**

- **The vehicles are identified in the resulting report "INL Fleet Vehicle Characterization Study for the U.S. Department of Navy"**

MCB Camp Pendleton Vehicle Analysis Summary

Analysis Summary – 49 Vehicles	
Total Distance (miles)	256,823.5
Total Drive Time (hours)	7,733
Daily Average Trip Distance (miles)	33.6
Percent of Days Driven	43.2%

MCB Camp Pendleton Vehicle Analysis Evaluation

- **Each set of Low, Med and High bars represent one existing fleet vehicle and how many days each year it would exceed the three BEV range scenarios. Graph represents 49 studied vehicles**

MCB Camp Pendleton - Days Vehices Exceed Range

MCB Camp Pendleton Analysis Recommendations

- **Vehicle Replacement No Impact - no vehicles**

- **Vehicle Replacement Impact of 1 to 10 Days – 22 vehicles**

- **Vehicle Replacement Impact of Greater Than 10 Days – 27 vehicles**

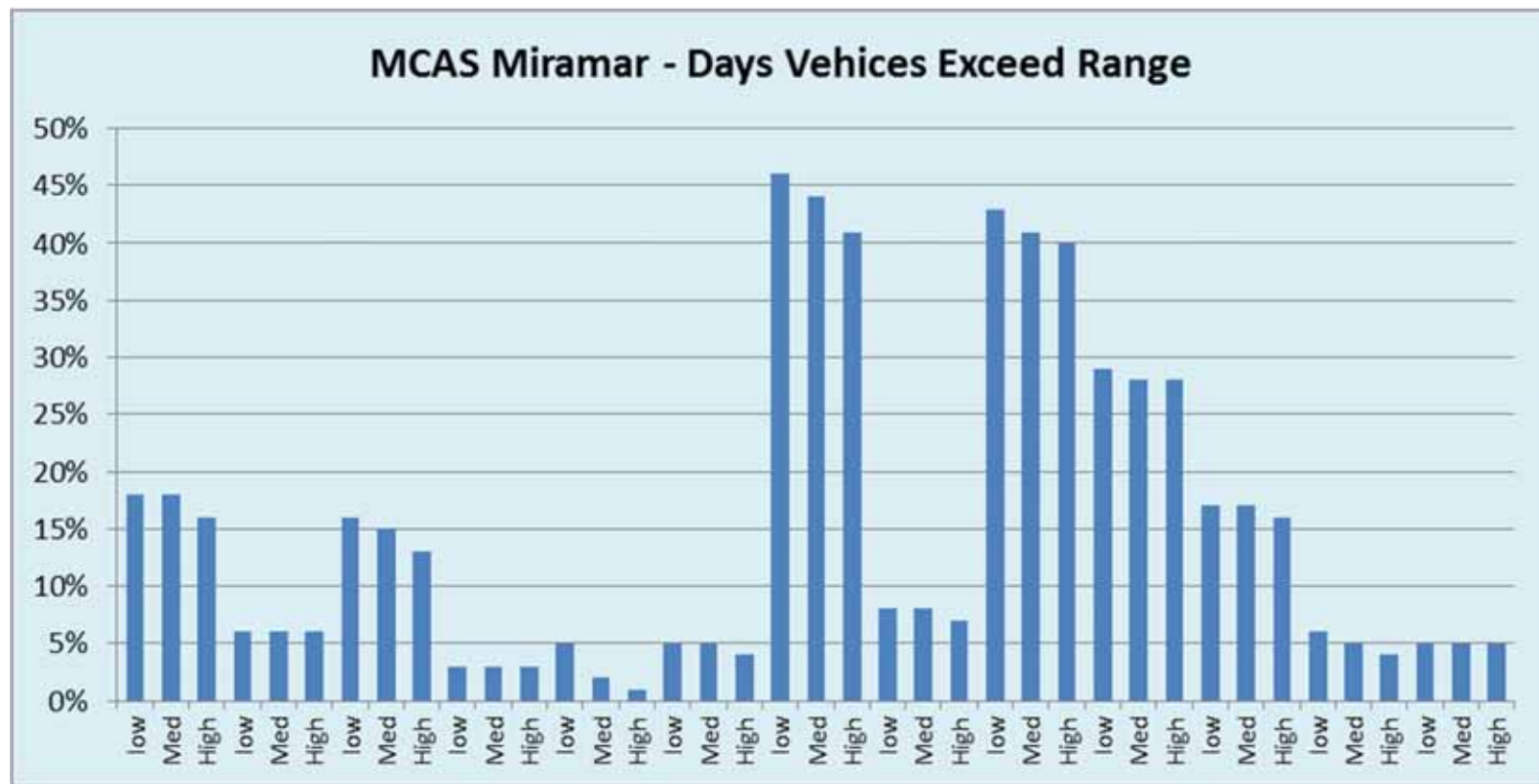- **No recommendations are made for 4 vehicles due to data quality**

MCAS Miramar Vehicle Analysis Summary

Analysis Summary – 13 Vehicles	
Total Distance (miles)	54,071.8
Total Drive Time (hours)	1,603
Daily Average Trip Distance (miles)	27.3
Percent of Days Driven	42.4%

MCAS Miramar Vehicle Analysis Evaluation

- **Each set of Low, Med and High bars represent one existing fleet vehicle and how many days each year it would exceed the three BEV range scenarios. Graph represents 13 studied vehicles**

MCAS Miramar - Days Vehices Exceed Range

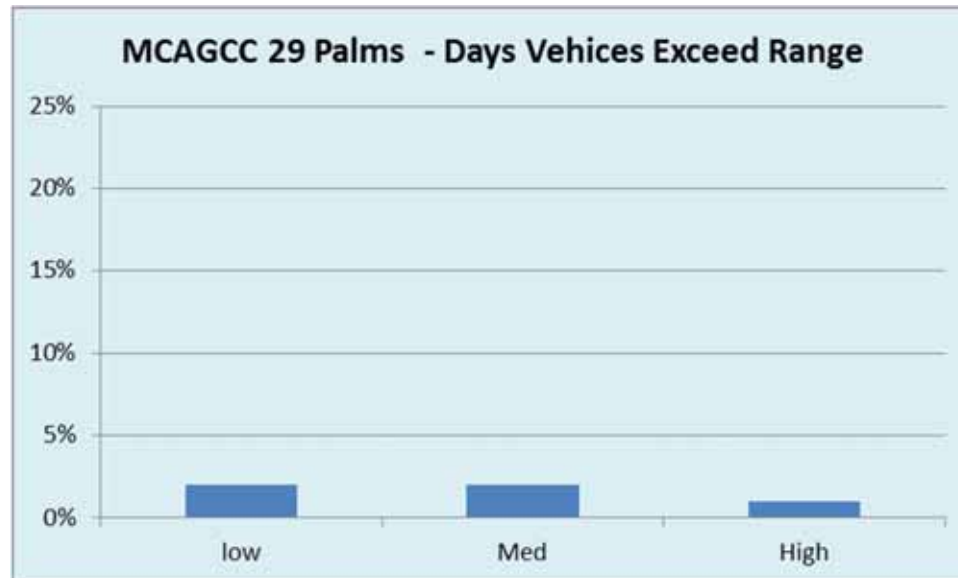# MCAS Miramar Analysis Recommendations

- **Vehicle Replacement No Impact - no vehicles**

- **Vehicle Replacement Impact of 1 to 10 Days – 6 vehicles**

- **Vehicle Replacement Impact of Greater Than 10 Days – 7 vehicles**

- **No recommendations are made for 1 vehicle due to data quality**

MCAGCC 29 Palms Vehicle Analysis Summary

Analysis Summary – 1 Vehicle	
Total Distance (miles)	5,688.2
Total Drive Time (hours)	279
Daily Average Trip Distance (miles)	18.5
Percent of Days Driven	91.9%

MCAGCC 29 Palms Vehicle Analysis Evaluation

- **The set of Low, Med and High bars represent the existing fleet vehicle and how many days each year it would exceed the three BEV range scenarios. Graph represents one studied vehicle**

MCAGCC 29 Palms - Days Vehices Exceed Range

MCAGCC 29 Palms Analysis Recommendation

- **This compact sedan vehicle may be replaced with a BEV, provided that another vehicle is available for the long-range driving this vehicle occasionally supported. Charging can be accomplished overnight or on days when the vehicle is not driven**

Summary

- **Of the ICEVs chosen for analysis, most can be replaced by BEVs a very high majority of days**

- **Further analysis could determine if:**
  - **All vehicles are driven the longest distances on all the same days**
  - **Or, if the high mileage days do not overlap, allowing a single ICEV to substitute for all other vehicles if they are replaced by BEVs**