

Caltrans Zero Emission Vehicle (ZEV) Experience



California Department of Transportation (Caltrans)
Division of Equipment (DOE)

Overview

- Governor Brown's Executive Order (EO) B-16-2012.
- DGS Management Memo 16-07 ZEV Increased Purchase Requirements.
- Caltrans ZEVs: Draft Implementation Action Plan.
- Electric Vehicles (EV).
- EV Charging Stations.
- Hydrogen Vehicles.
- Hydrogen Fueling Stations.
- Hydrogen Opportunity Dispensers.
- Fuel Cell Street Sweeper.
- Renewable Diesel

Governor Brown's Executive Order B-16-2012

Reduce transportation-related greenhouse gas emissions by 80 percent below 1990 levels by 2020.

The Governor's Executive Order establishes several milestones organized into three time periods:

By 2015

- The state's major metropolitan areas will be able to accommodate ZEVs through infrastructure plans and streamlined permitting
- Private investment and manufacturing in the ZEV sector will be growing
- The state's academic and research institutions will contribute to ZEV market expansion by building understanding of how ZEVs are used

By 2020

- The state's ZEV infrastructure will be able to support up to 1 million vehicles
- The costs of ZEVs will be competitive with conventional combustion vehicles
- ZEVs will be accessible to mainstream consumers
- There will be widespread use of ZEVs for public transportation and freight transport

By 2025

- Over 1.5 million ZEVs will be on California roadways and their market share will be expanding
- Californians will have easy access to ZEV infrastructure
- The ZEV industry will be a strong and sustainable part of California's economy
- California's clean, efficient ZEVs will annually displace at least 1.5 billion gallons of petroleum fuels

Goals of the Governor's 2016 ZEV Action Plan

1. Achieve mainstream consumer awareness of ZEV options and benefits
2. Make ZEVs an affordable and attractive option for drivers
3. Ensure convenient charging and fueling Infrastructure for greatly expanded use of ZEVs
4. Maximize economic and job opportunities from ZEV technologies
5. Bolster ZEV market growth outside of California
6. Lead by example integrating ZEVs in to state government

Increased State ZEV Purchase Requirements

Beginning in Fiscal Year (FY) 2017/2018, state agencies will be required to increase their annual ZEV purchasing requirements by 5% each year through FY 2024/2025. As EO B-16-12 presently directs each state agency to ensure that at least 10% of its annual, light-duty fleet purchases be ZEV, a state agency will now be required to increase its annual light duty ZEV purchasing as follows:

Fiscal Year	EO B-16-12 ZEV Purchasing Requirements
2014/2015	10%
2015/2016	10%
2016/2017	10%
2017/2018	15%
2018/2019	20%
2019/2020	25%
2020/2021	30%
2021/2022	35%
2022/2023	40%
2023/2024	45%
2024/2025	50%

California 2016 ZEV Action Plan

- 30 DC fast charging stations – Install public DC fast chargers at a minimum of 30 locations, including highway rest stops and other strategically located Caltrans properties.
- 3 hydrogen locations – Identify at least 3 strategically located Caltrans properties to support development of retail hydrogen stations.
- Support workplace charging – Data collection for all Caltrans workplace facilities in progress to identify at least 5% of employee parking spaces to have EV charging available.

30 DC Fast Chargers

Timeframe: End of 2018
to be in construction.



Number of ZEVs in the Caltrans fleet

Caltrans ZEV Makes and Models

- 11 Nissan Leafs (BEV)
- 54 Toyota Rav4 (BEV)
- 20 Toyota Mirais (FCEV)
- 35 Chevrolet Volts (PHEV)
- 14 Toyota Prius (PHEV)

Caltrans ZEV Applications

- 43 ZEVs are used in a motorpool;
- 2 ZEVs are used for Building Operations;
- 54 ZEVs are used by the Caltrans Construction Program;
- 3 ZEVs are used by the Equipment Shops;
- 11 ZEVs are used by the Caltrans Maintenance Program;
- 1 ZEV is used for Project Development;
- 1 ZEV is used for Right of Way Management;
- 19 ZEVs are used for Traffic Operations.

Caltrans ZEV Credits

- Currently Caltrans has 82 ZEV credits.
- Next year will add 57 ZEV credits from 93 more ZEV planned purchases.

Chevy Bolt Charging Ability

Charging Level	Charging Rate	Full charge
Level 1: 120 V/12A	4 miles/hr	60 hours
Level 2: 240 V/32A	25 miles/hr	9.5 hours
DC fast charge: 480 V/50A	180 miles/hr	1.3 hours

17 Bolts to be on order fiscal year 17/18

EV Charger Level Comparison

Level 1 (120 VAC)	1.4 kW	4 miles/hr	\$0 to \$\$ for Site Prep
Mobile Solar Charger	3.5 kW	10-1/2 miles/hr	\$65K to \$75K
Level 2 (240 VAC)	6.6 kW	20 miles/hr	\$3K to \$\$ for Site Prep
DC Fast	25 kW	75 miles/hr	\$20K to \$\$ for Site Prep

Current Charging Station Infrastructure

179 built or planned level II charging stations at Caltrans facilities (through June 2017).

- 17 Solar powered mobile EV chargers.
- 84 (dual) fixed EV chargers currently in operation.
- In excess of 78 EV chargers plan to be install through the end of 2017.
- Chargers available on state contract for set in place applications.
- Site preparation contracts for fixed charger installation can be difficult.
- Some site preparation done with in-house labor.
- Free employee workplace charging allowed.
- State Fire Marshall permits needed for both mobile and fixed chargers.
- Caltrans Policy: Provide an EV charger with each vehicle. Customer makes arrangements to install the EV charger.

Caltrans EV Charging Station Locations and Quantity

Region	In Use (permanent stations)	Solar Chargers In Use	Future Plan
North region (D1,2,3 & HQ)	17	4	7
Central (D4,5,6,&10)	35	5	30
South (D7,8,11&12)	32	8	41
Summary	84	17	78



Emerging Market for Fuel Cell Vehicles (Hydrogen)

- Range and fueling time better than electric.
 - Refueling time: 5 to 10 min., H2 Retail vs. 5 to 6 hours, Level II.
 - Range: 265 to 312 miles vs. 60 to 120 miles with EV.
- The Toyota Mirais offer \$15,000 in the first three years of free fuel from Toyota and a \$5,000 clean air rebate from Air Resources Board.
- Infrastructure improving with 25 open retail hydrogen fueling stations, but there are 16 proposed retail hydrogen fueling stations across California.
- Simple Fuel opportunity refueler coming on the market.

Toyota Mirai (Fuel Cell Vehicle)



- Price: \$46,570
- Range: 312 miles (EPA)
- Refuel time: 5 minutes (fast fill)
- “Free” fuel: 3 years or \$15,000, whichever comes first.
- Rebate: \$5,000 per vehicle

Hyundai Tucson



- Lease: \$499/month
- Range: 265 (EPA)
- Refuel time: 10 minutes (fast fill)
- Emission: 0
- Note: Eligible for CA white HOV carpool sticker
- Can replace some pickup and SUV applications, e.g., 20-40 customer commitments.

Leasing Issue: Insurance

- Problem: Hyundai requiring independent insurance coverage making cost prohibitive. State of California is self insured.
- Possible Solutions:
 - Hyundai accepts the State of California self insurance.
 - Caltrans purchases vehicle in lieu of lease.
- Preference: Leasing best for Caltrans to allow for updating fleet with updated technology when new models are released.

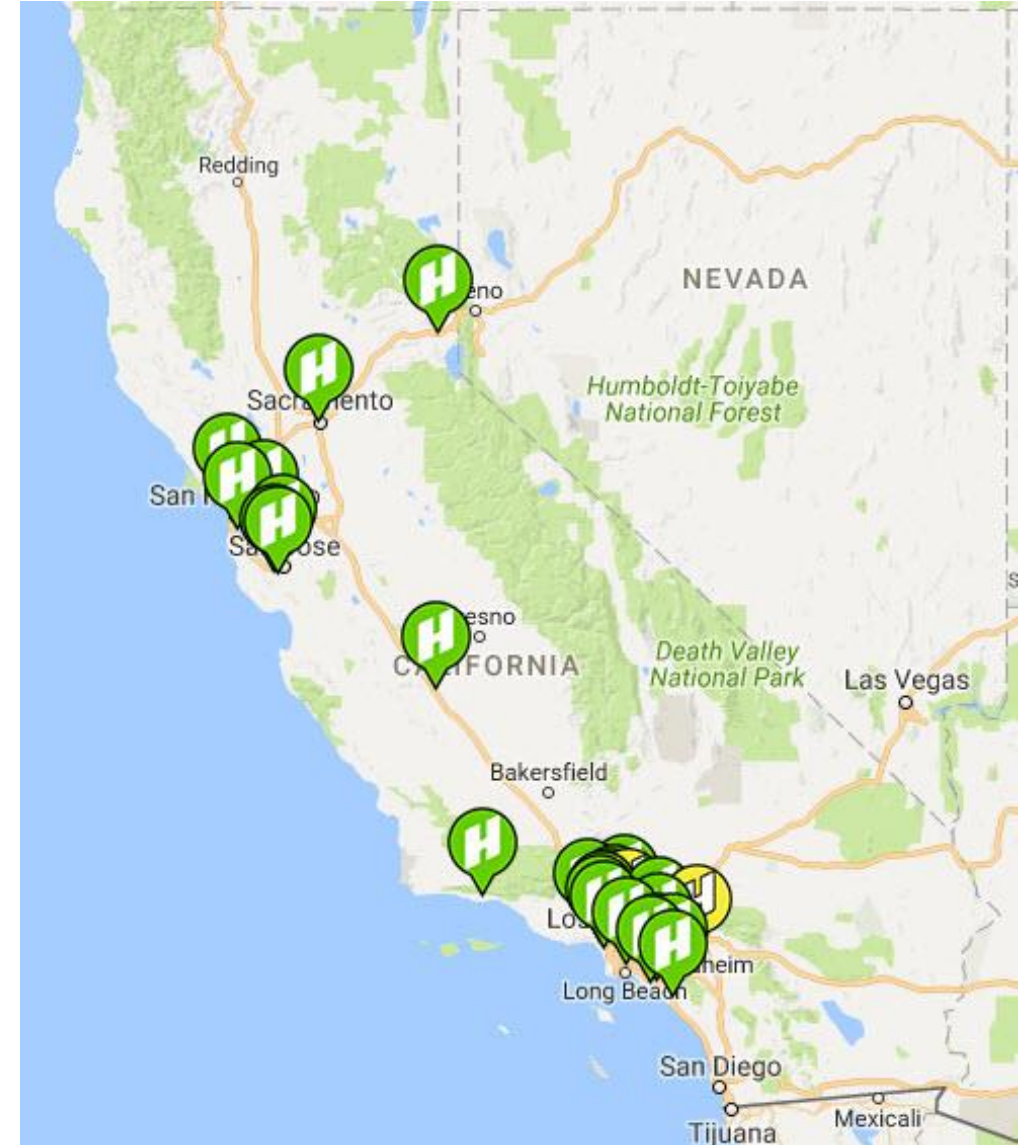
25 California Retail H2 Refueling Stations

- 9 retail stations in Northern California
- 15 retail stations in Southern California
- 1 in Central California

<http://cafcp.org/stationmap>

Recent Update: CEC funding for 16 new stations:

- 10 for Northern California
- 5 for Southern California
- 1 for Central California

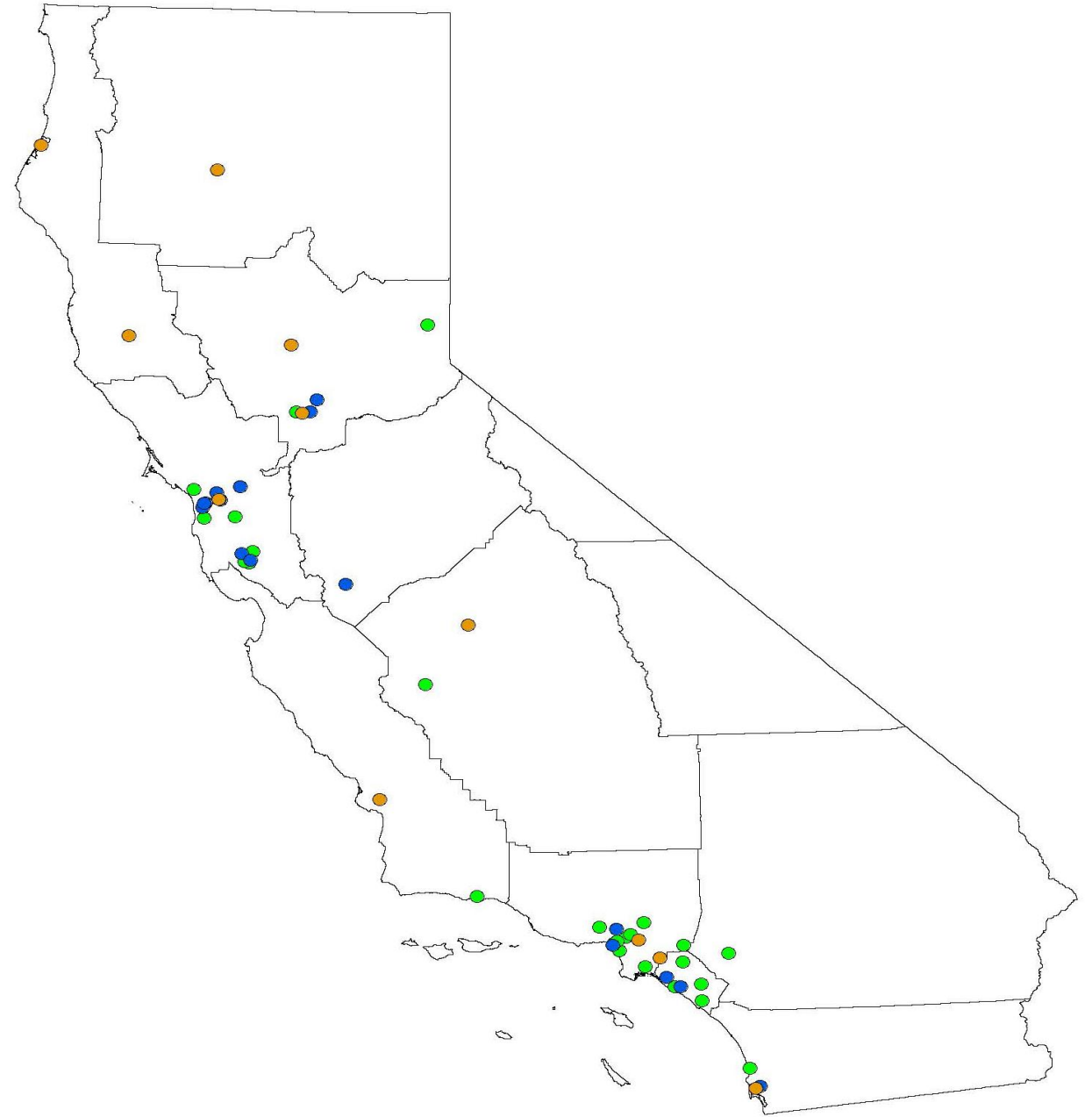


Simple Fuel H2 Opportunity Refueling Appliances

- Winner of USDOE \$1 Million H-Prize.
- Refueling: 60-120 miles up to 30 min.
- 6-1/2' tall with 6-1/2'x4' footprint.
- ~\$300,000 ea (installed – qty 10).
- Inputs: voltage & water.
- Output: Oxygen vent.
- Will incorporate a level II EV charger.
- Currently seeking approval for non-competitive purchase.
- ETL Mark and Vehicle Mfgr approval in process.



Hydrogen Refueling Infrastructure



Caltrans' Current and Next Years ZEV Fleet

			Total
Battery Electric Vehicle (BEV)	Rav4 EV	Active	65
	Leaf	17/18	15
Plug-In Hybrid Electric Vehicle (PHEV)	Volt	Active	49
	Prius Plug-In	17/18	61
Hydrogen Fuel Cell Vehicle (FCV)	Mirai	Active	20
		17/18	17
Total ZEV/EV			226

Projected 5 Year ZEV Purchase Plan

	FY 17/18	FY 18/19	FY 19/20	FY 20/21	FY 21/22	TOTALS
Non-ZEV Vehicles	296	137	128	121	122	804
BEV & PHEV	76	8	4	4	51	143
FCV	17	26	39	48	13	143
Total Light Duty Requested	389	171	171	173	186	1090
% of Light Duty requested that's ZEV	24%	20%	25%	30%	34%	N/A
DGS ZEV % Requirement	15%	20%	25%	30%	35%	N/A
ZEV Credits Earned	93	34	43	52	64	286
ZEV Credits Required	59	35	43	52	66	255

Future

- Heavy duty vehicle purchase requirements are being looked at, e.g., AB 739 introduced February 15, 2017 requiring by December 31, 2030, at least 30 percent of heavy-duty vehicles purchased by the Department of General Services and any other state entities for the state fleet shall be zero-emission.
- Purchased hybrid electric street sweepers: Hydrogen for delivery in Fall 2017.

Hydrogen Hybrid Electric Street Sweeper

- Meets Caltrans' Std. Sweeping Performance Specs.
- 33,000 GVWR
- 4 cu yard hopper
- 65 mph top speed



Renewable Diesel

Project Description

In September of 2015 Caltrans Division of Equipment decided to be pro-active and test Renewable Diesel (RD) fuel in two locations. This action was to determine the effects of RD fuel on the Caltrans diesel fleet, primarily vehicles with retrofitted Diesel Particulate Filters (DPF). This test included 33 vehicles stationed above 5,000 ft. elevation at Whitmore and Woodfords Maintenance stations.

The scope of the test increased in December 2015 with Department of General Services (DGS) Memo MM 15-07, which mandated all state agencies to purchase RD fuel for all bulk fueling locations throughout the state. Caltrans began full scale implementation in January 2016, fueling over 4,000 diesel engines, with bulk fuel tanks in 250 locations statewide.

Caltrans used RD fuel statewide with no significant problems for almost one year.

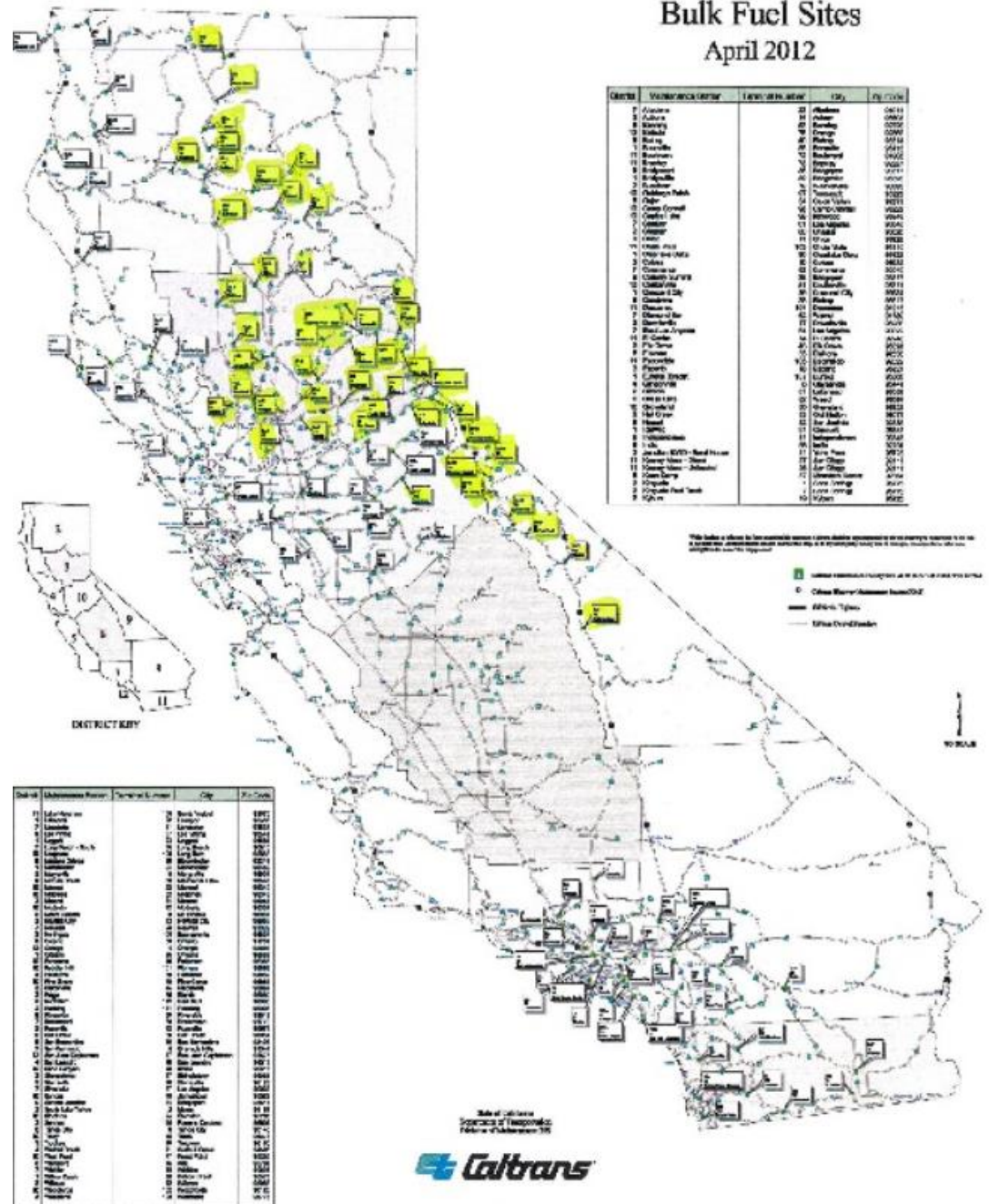
On December 27, 2016, District 9 (Mono County) and District 2 (Redding) Maintenance stations reported gelling of the RD fuel in multiple locations at ambient temperatures ranging from -1 to -22 degrees Fahrenheit. District 10 also reported some gelling issues in their coldest and higher elevation maintenance facilities. Districts 2, 3, 9 and several D-10 Maintenance locations are now reporting leaking bulk fuel tank pumps and seals.

Caltrans
AUTOMATED
Bulk Fuel Sites
April 2012

Organizational Impact

District 9 had over 26,000 gallons of gelled RD fuel in multiple locations that had to be liquefied in order to be pumped out by a vendor.

Districts 2, 3, and 9 have experienced multiple vehicle breakdowns and massive downtime associated with the RD fuel gelling issues. Some vehicles with DPF have had to complete the regeneration cycle 4 times more often using RD fuel.



Organizational Impact (cont.)

Operations has instructed any Caltrans facility or equipment shop having issues with RD to immediately begin using regular Ultra Low Sulfur Diesel (ULSD) fuel with the winterizing agent added. At present, 71 locations are using ULSD and 179 locations are still using RD fuel. Caltrans is working with DGS, CDFA, Neste Fuels, and bulk fuel distributors to identify the root cause of these RD fuel problems.

Fuel Samples

Initial lab testing of the fuel indicates the cloud points are much higher than what should be seen in RD fuel manufacturer specifications. Cloud points of the test samples ranged from 12 to 15 degrees Fahrenheit and should be in the -6 to -10 degree Fahrenheit range.



Conclusion

Caltrans is still using RD fuel in 179 bulk fueling locations throughout the state, in places where no issues or negative problems have occurred. Generally, these locations are lower elevations in warmer climates.

Thank You



Questions??