

GM Update on Flex-Fuel Vehicle Challenges in CA

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Western Region Clean Cities Coordinator Peer Exchange
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California Emission Standards and E85 Flex-Fuel Vehicles

- FFVs fueled with E85 are generally cleaner than gasoline vehicles
- But there are conflicts between the California emission standards and E85 FFVs that are causing sales restrictions
- FFVs fueled with E85 yield large reductions in greenhouse gas emissions
- But the California greenhouse gas regulations provide no practical incentive for E85 FFVs

E85 Is Cleaner than Gasoline

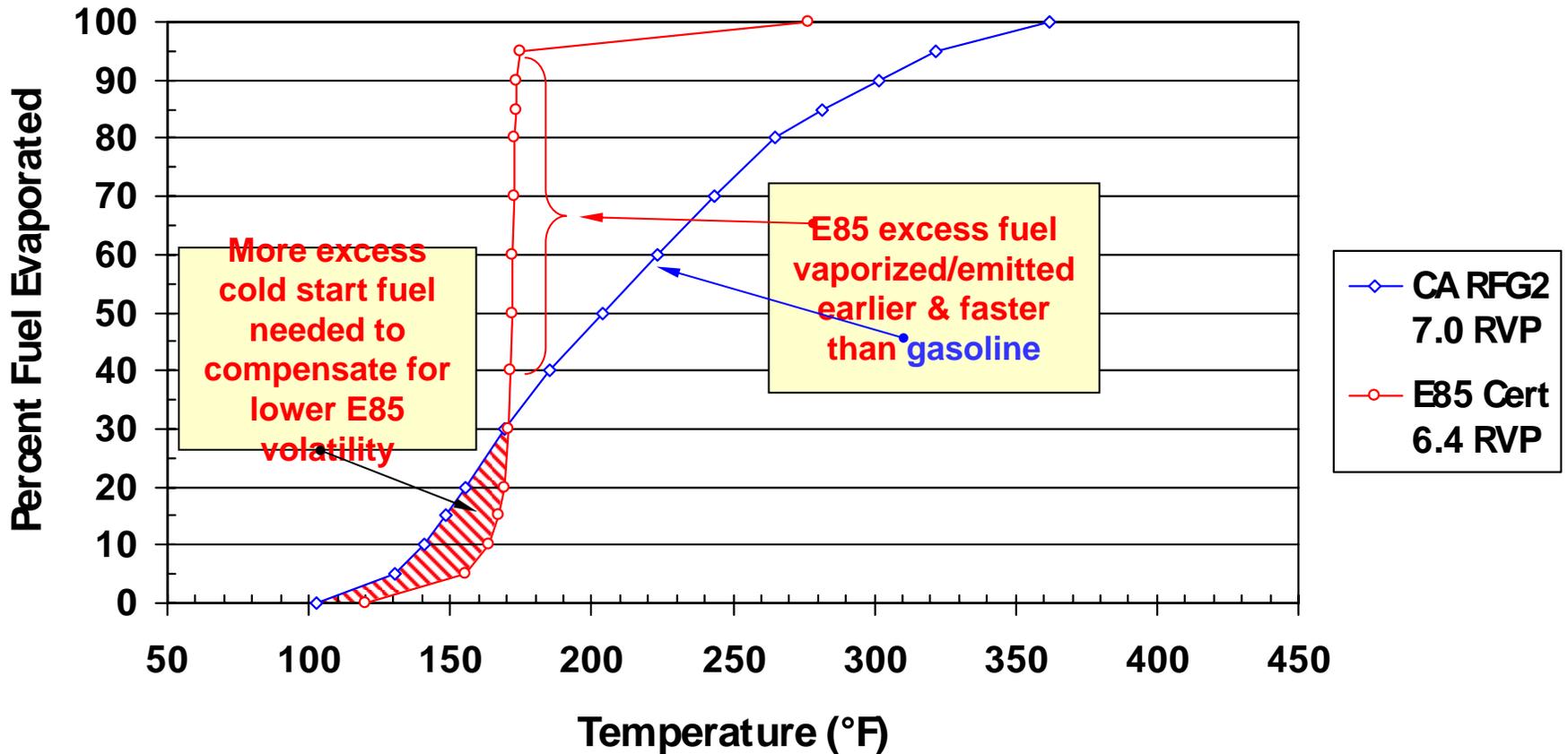
- Flex-fuel vehicles are generally cleaner when fueled with E85 than with gasoline
- Tailpipe emissions are lower
 - Lower NO_x
 - Lower CO
 - HC about the same on a reactivity adjusted basis
- Evaporative emissions are lower
 - Lower permeation
 - Lower vapor pressure

Conflict Between California Standards & E85 FFVs

- The most stringent categories of the California emission standards present unique technical challenges
- California SULEV exhaust standard technical challenges
 - Compliance required on E85 as well as gasoline
 - Compliance required at normal temperature (75F) and cold temperature (50F)
 - Control of non-methane organic gas (NMOG) emissions during cold start more difficult on E85 due to the different volatility characteristics of E85
 - NMOG emissions exceed NMOG standard before catalyst warmed-up
- California zero evaporative emissions standard technical challenges
 - Evaporative emissions compliance requires testing on worst-case blend (E10)
 - Higher permeation and vapor pressure than E85 and gasoline (E0)

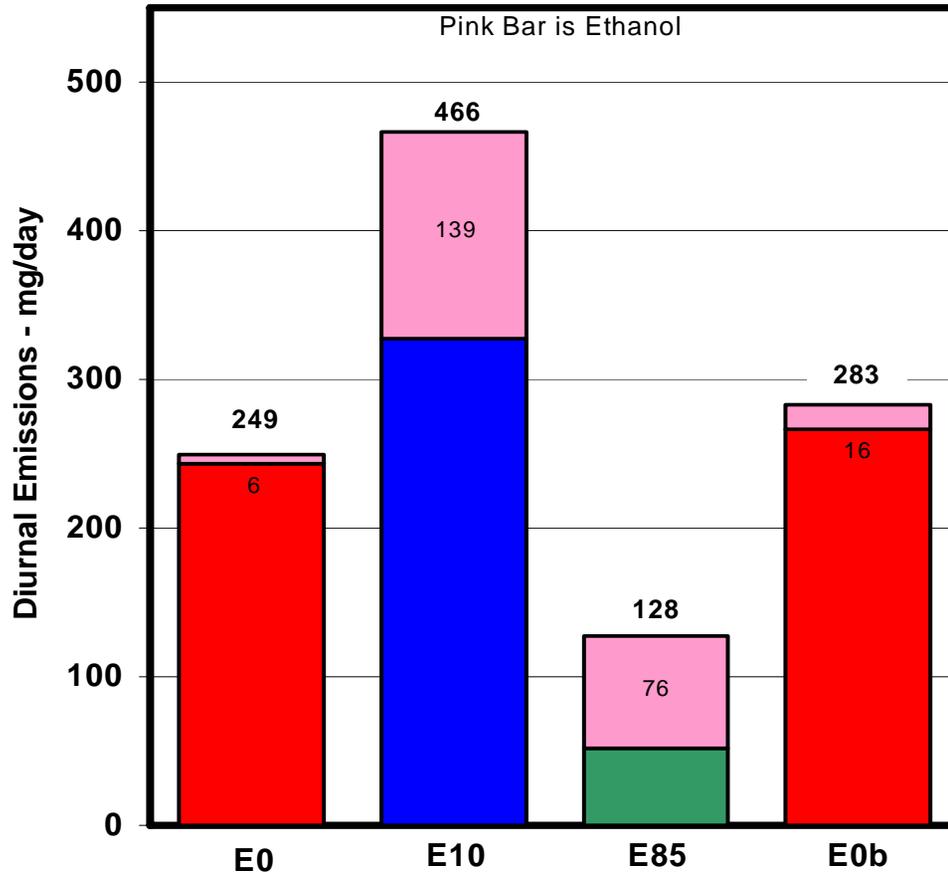
Physics behind the NMOG Challenge

Distillation Curves- Gasoline & E85 Cert Fuels



Evaporative Permeation Impact of E85 (CRC E65.3)

Diurnal Emissions Comparison - Rig 14



Conflict Between California Standards & E85 FFVs

- Compliance with SULEV exhaust standard is required under California's LEV regulations
 - Fleet NMOG average
- Compliance with SULEV exhaust standard is also required under California's ZEV regulations
 - PZEV exhaust requirement
- Compliance with zero evaporative emission standard is required under California's ZEV regulations
 - PZEV evaporative requirement

California and Federal
 FTP Exhaust Emission Standard Categories
 Cars & Trucks \leq 8500 lbs GVWR
 (Full Useful Life, Grams/Mile)

	NMOG	NOx	NMOG + NOx
ZEV/BIN 1	0	0	0
SULEV/BIN 2	0.01	0.02	0.03
BIN 3	0.055	0.03	0.085
BIN 4	0.07	0.04	0.11
ULEV	0.055	0.07	0.125
LEV/BIN 5	0.09	0.07	0.16
BIN 6	0.09	0.1	0.19
BIN 7	0.09	0.15	0.24
BIN 8	0.125	0.2	0.325

Conflict Between California Standards & E85 FFVs

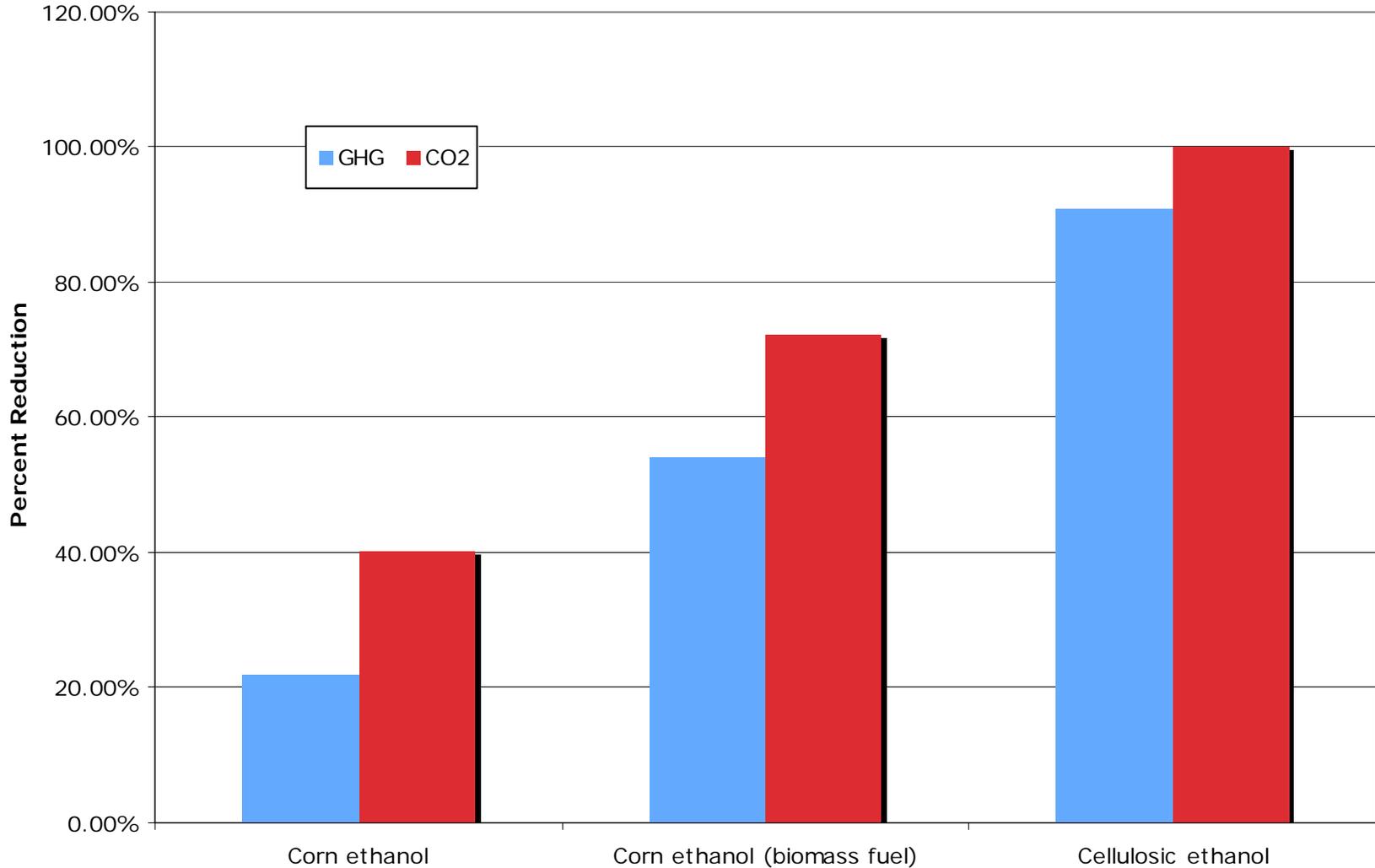
LEV Regulations	ZEV Regulations
LEV	--
ULEV	--
SULEV	PZEV (SULEV + zero evap)
ZEV	ZEV

- E85 FFVs have not achieved the SULEV or PZEV standards
- Because of this, sales of E85 FFVs are being restricted in California and all states that have adopted the California standards
- These sales restrictions will grow going forward
 - As more SULEVs and PZEVs are required for compliance
 - As more FFV models are introduced

FFVs Fueled with E85 Reduce Greenhouse Gas Emissions

- On a lifecycle basis, ethanol provides large reductions in CO₂ and greenhouse gas emissions compared to gasoline
- FFVs fueled with E85 represent the best opportunity to reduce greenhouse gases from the motor vehicle fleet, particularly in the near term

Ethanol Percent Reduction in Lifecycle GHG or CO2 on Energy Basis from Gasoline
(Source: EPA Renewable Fuel Standard RIA, April 2007)



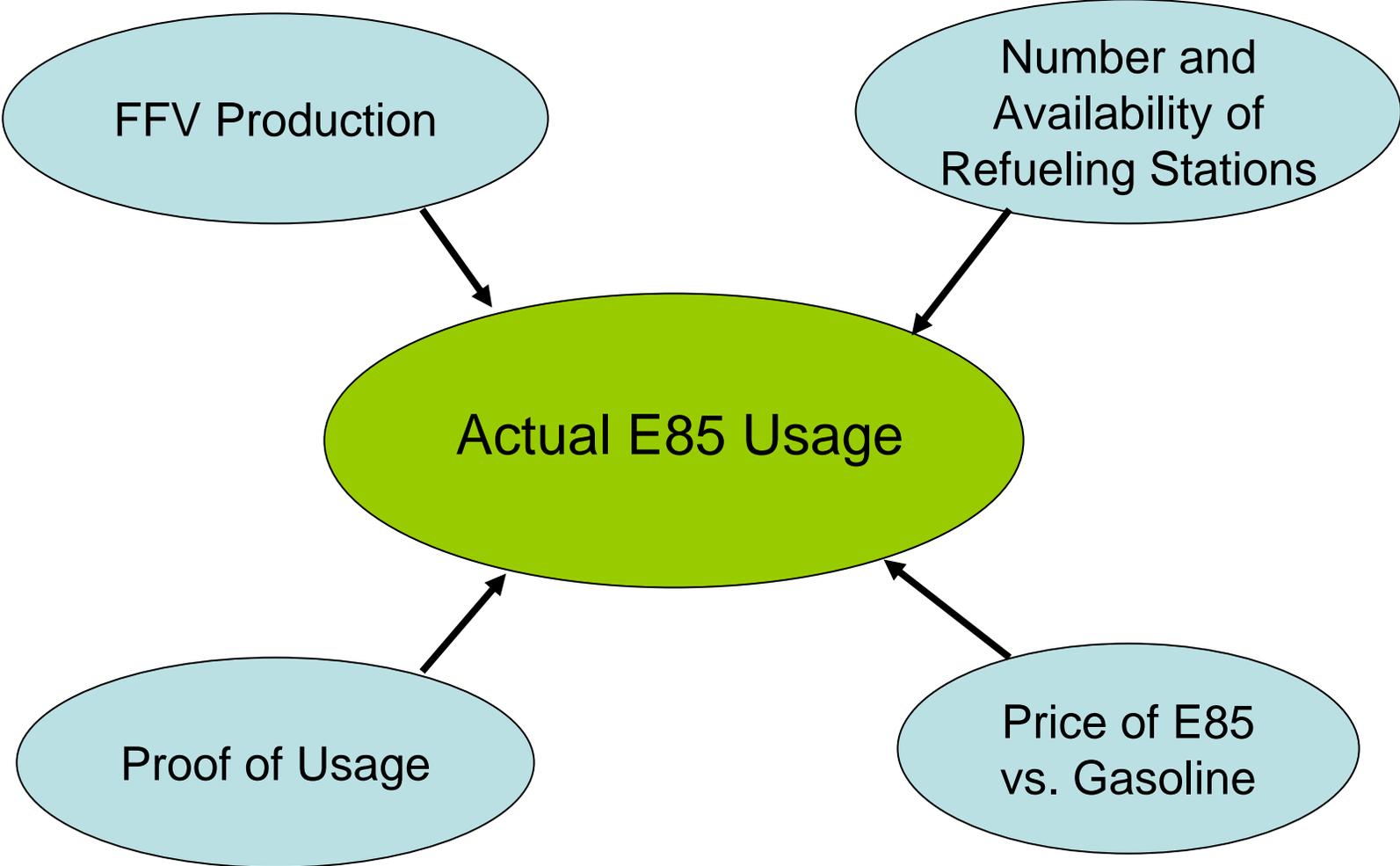
California's Greenhouse Gas Regulations Provide No Practical Credit for E85

“The manufacturer shall also provide data demonstrating the percentage of total vehicle miles traveled by the ... vehicles sold to each fleet ... using the alternative fuel and using gasoline.”

-- California Code of Regulations, 1961.1(a)(1)(B)2.a.i.

- Flex fuel vehicles only get credited for E85 greenhouse gas benefit to the extent that the OEM can prove to CARB that the alternative fuel is actually used by the customer

Proving Actual E85 Usage



Auto manufacturer only controls FFV production.

Questions?