Presentation to Clean Air Act Advisory Committee, Mobile Sources Technical Review Subcommittee

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California Reformulated Gasoline

Current Requirements and California's Strategies for Reducing Greenhouse Gas (GHG) Emissions

Requirements and Short-term Strategies

* The California Reformulated Gasoline (CaRFG) Regulations, 13 CCR 2250 et seq.,
  - Require that all California motor-vehicle gasoline be produced according to specifications determined by the California Predictive Model
  - Allow the use of ethanol at 0 to 10 percent by volume
* The Low Carbon Fuel Standard (LCFS) Regulations, 17 CCR 95480 et seq., require carbon intensity (CI) (grams CO_2 equiv./MJ) percent reductions relative to CaRFG produced in 2010, as follows:

Year	2016	2017	2018	2019	2020
Percent	2.00	3.50	5.00	7.50	10.00

California Predictive Model

* Correlates emissions with fuel properties to determine emission-equivalent fuel specifications
* Developed from test data from 42 studies, 10368 observations, on 1359 vehicles with 336 test fuels
* Test-fuel oxygenate (MTBE, ethanol) contents ranged from oxygen-equivalent of 0- to 10-percent ethanol
* Exhaust, evaporative, and supplemental permeation emissions studies were included
* Model predicts emission differences from reference for NOx, exhaust HCs, evaporative HCs, CO, ozone-forming potential, and toxic air contaminants
* Determines specifications for oxygen, sulfur, total aromatic hydrocarbon, benzene, and olefin contents, as well as T90, T50, and Rvp
* Octane is not one of the specifications of CaRFG

California Certification Gasoline

* Fuel used to certify new vehicles
* Certification gasoline specifications[1] for LEV III vehicles:

Ethanol	9.8-10.2 vol. %	**Olefins**	4.0-6.0 vol. %
Oxygen	3.3-3.7 wt. %	**T90**	310-320 °F
Sulfur	8-11 ppmw	**T50**	205-215 °F
Aromatic HC	19.5-22.5 vol. %	**Rvp**	6.9-7.2 psi
Benzene	0.6-0.8 vol. %	**Octane (R+M)/2**	87-88.4, 91 (min)[2]

* [1] Abbreviated table.
* [2] For vehicles/engines that require the use of premium gasoline as part of their warranty, the Octane ((R+M)/2) may be a 91 minimum. All other certification gasoline specifications must be met.

Short-term GHG Strategies for SI Engine Fuel – Low Carbon Fuel Standard

* LCFS regulations require a 10-percent reduction in CI by 2020
* Potential strategies for compliance
  * Use of low carbon-intensity oxygenated additives
    - Lower-carbon-intensity ethanol at 10 percent by volume
    - Other low carbon-intensity oxygenated compounds at equivalent oxygen content (3.3 to 3.7 percent by wt.) to 10-percent ethanol
      - Must undergo multimedia evaluation
      - May be allowed to use existing California Predictive Model if multimedia evaluation demonstrates no harm
      - Iso-butanol at 16 percent is undergoing multimedia evaluation
  * Replacement with electricity
  * Replacement with alternative fuels
  * Replacement with renewable gasoline

Long-term GHG Strategies for SI Engine Fuel - Phase-out Fossil Fuel Use

* Replacement with electricity
* Replacement with alternative fuels
* Replacement with renewable gasoline

Potential Ways of Increasing Gasoline Octane and Issues to Evaluate

* Changes in refinery blendstocks
  - Increases in isomerate and alkylate
  - Increases in oxygen content by increasing volume or changing type of oxygenated additives
* Evaluate the criteria, toxic, and GHG emissions impacts of the potential ways to increase octane
* Re-evaluate engine behavior

E15 and Octane Considerations

* Requiring higher ethanol content and higher octane would be compatible because ethanol has a high blending octane number, however they would be separate regulations which would each require significant additional resources.
* E15
  - E15 could have GHG benefits, but other impacts are uncertain.
    - Materials compatibility impacts on vehicles, other gasoline engines, and fuel distribution infrastructure
    - Emissions impacts from LDVs of different vehicle technology classes
    - Performance of other(non-light-duty vehicle) gasoline engines (SOREs, off-road recreational, MD trucks, motorcycles, etc.)

E15 and Octane Considerations (continued)

* E15 (continued)
  - …other impacts… (continued)
    - Emissions speciation and reactivities (ozone-forming potential)
    - Photochemical modeling
    - Toxic air contaminant emissions
  - Developing E15 regulations would take a minimum of 6 years (2-3 years planning, 2-3 years testing, 2-3 years rulemaking). This would include fuel testing for criteria and toxic pollutant emissions performance, both exhaust and evaporative, an update to the California predictive model, and a full multimedia evaluation.

E15 and Octane Considerations (continued)

* E15 (continued)
  - This process would be highly contentious and involve the biofuel industry, the automakers, the refiners, environmentalists, AAA and consumer groups.
  - The potential for E15 to produce significant GHG benefits is contingent on whether it would be used as a long-term fuel (i.e., is E15 a necessary bridge to get to a drop-in renewable gasoline or a strong transition toward ZEVs).
  - Legal challenges from AAA and others would be a possibility.

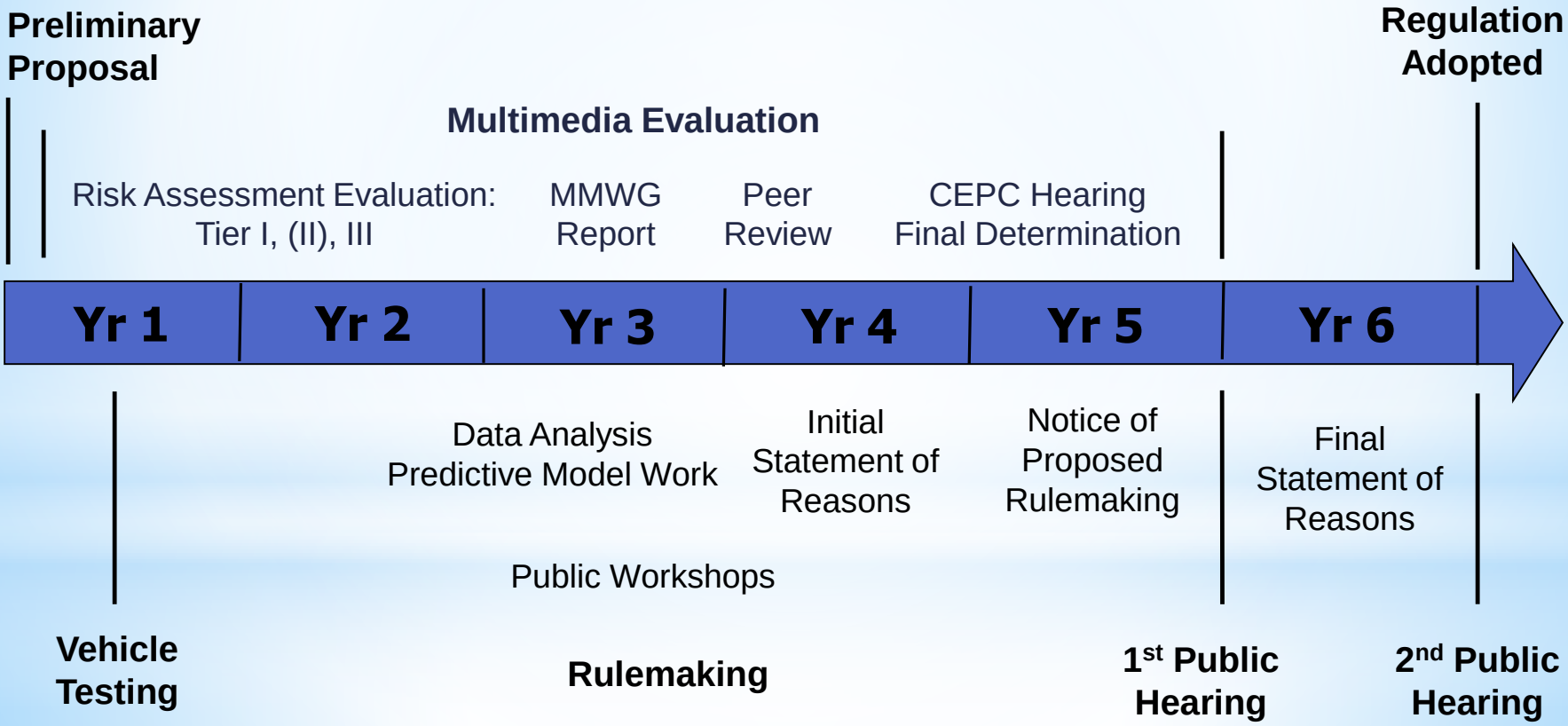
E15 and Octane Considerations (continued)

* Octane
  - Increasing the octane number of gasoline would allow the use of spark-ignition engines with higher compression ratios and higher thermal efficiencies.
  - A regulation that requires an increase in the octane number of CaRFG would also take a minimum of 6 years of work, and it might not result in additional efforts to increase vehicle efficiency, than already required by LEV GHG standards.
  - We would need to amend ARB's certification test procedures to allow the use of high-octane certification gasoline for vehicles that would be required to use high-octane commercial gasoline.
  - Enforcement — how to prevent mis-fueling with low-octane fuel

Process for Amending the CaRFG Regulations

* Review available data to determine potential impacts and need for further data for different vehicle classes
* Work with industries to determine how to perform additional emissions and compatibility studies
* Initiate studies to collect additional data
* Use new data to revise predictive model correlations
* Evaluate GHG emissions impacts
* Work with gasoline marketers and distributors to devise plans for storing, distributing, and dispensing new gasoline
* Develop regulations and perform multimedia evaluation
* Hold workshops, ARB hearing, and EPC hearing

Rulemaking Timeline
(Fuel Specifications - *General*)



Multimedia Evaluation Process

- Multimedia evaluation (*HSC §43830.8*) must address:
  - Emissions of air pollutants
  - Contamination of surface water, groundwater, and soil
  - Fate and transport mechanisms
  - Disposal or use of byproducts and waste materials
- Review by Multimedia Working Group (MMWG)
- MMWG Staff Report – Recommendations to California Environmental Policy Council (CEPC)
- External Scientific Peer Review (*HSC §57004*)
- Address Comments and Finalize Staff Report
- CEPC Public Hearing
- Final Determination by CEPC

Multimedia Evaluation Tiers

Tier I
Work Plan

Work Plan
- Define framework and approach
- Identify information needs and gaps
- Feedback provided

Tier II
Risk Assessment Protocol

Risk Assessment Protocol
- Experimental design developed and submitted
- Protocol reviewed, feedback provided for Tier 3

Tier III
Final Report Multimedia Risk Assessment

Final Report Risk Assessment
- Final report is used as the basis for recommendations submitted to the Environmental Policy Council
- Final report is peer reviewed

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