

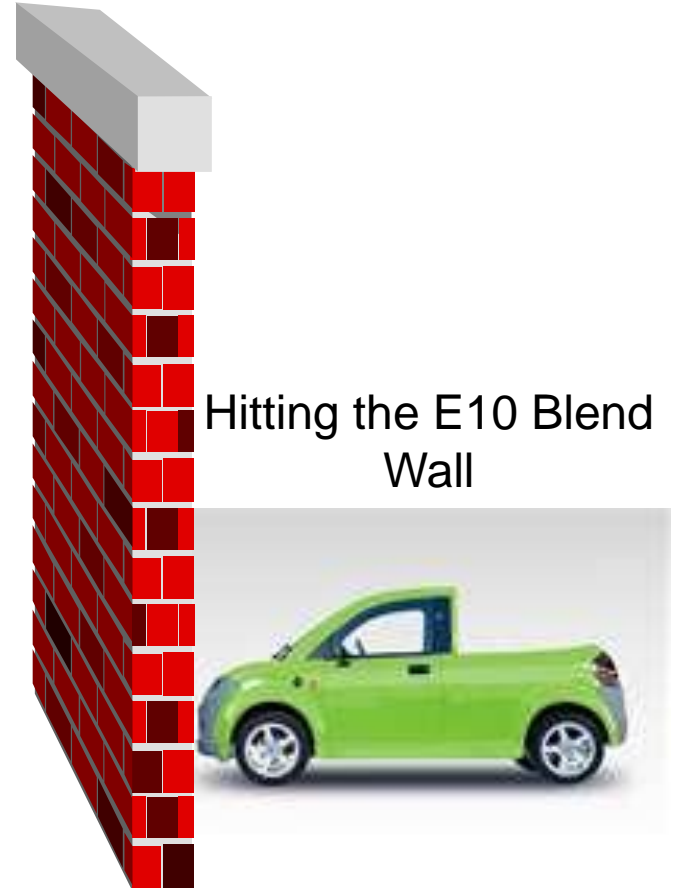
Working Toward the Renewable Fuel Standard

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Developing A Ready End-Use Market for Ethanol



- More than 9 billion gallons of ethanol were used in the U.S. in 2008
 - More than 99% used in the form of E10
 - E10 market will be saturated at about 14 – 15 billion gallons
- DOE strategy for expanding ethanol use
 - Determine feasibility of using intermediate ethanol blends (e.g., E15, E20) in conventional vehicles (non-flex fuel vehicles)
 - Expand E85 by targeting specific regions/cities to establish high concentration of FFVs and infrastructure
- EPA has authority to issue a “substantially similar” waiver to allow alternative fuels to be used in place of gasoline
 - Consider effects on durability, driveability, materials, and emissions



DOE's Intermediate Blends Effort



- Sponsored by DOE's Biomass and Vehicle Technologies Programs
- DOE initiated analysis in Spring 2007
 - Small, non-road engines given priority in Summer 2007 at EPA request
 - Vehicle evaluations began late CY 2007
- Leveraging work of other stakeholders (CRC, EPA and others)
- Working in close coordination with EPA to ensure test data can effectively address analytical questions
- DOE has invested approximately \$15M (additional \$6M from partners co-funding) through FY2008 on testing of intermediate ethanol blends. Additional \$12+ million in funding planned.



DOE's Intermediate Ethanol Blends Test Program



- The DOE test program is evaluating --
 - Vehicle exhaust and evaporative emissions
 - Catalyst durability and aging
 - Cold-start operation and drivability
 - Fuel-system and catalyst materials compatibility
- DOE is also evaluating impacts of higher ethanol blends on small engines and infrastructure components
 - Tested leaf blowers, line trimmers, pressure washers, and small generators
 - Expanding test plan for other non-automobile engines and infrastructure components.



Completed Testing



Vehicles

- Emissions and Catalyst Temperature Pilot Study (16 vehicles)
 - Tests of 13 vehicles completed last year – Report #1 published October 7, 2008
 - Final 3 vehicles completed December 2008 – reported in February 2009 in a Revised Report #1
- Tailpipe Emissions (with EPA) (22 vehicles, 31 different fuels)
 - Phase 1 (75 F) and Phase 2 (50 F) completed; 3 total phases
- Cold Start and Driveability (with CRC) (6 vehicles)
 - Sub 50 F testing completed - CRC Report No. 652 issued Oct 2008
- Evaporative Emissions (with CRC and EPA) (8 vehicles)
 - Project E-77-2 testing complete, CRC report expected 2nd Quarter 2009

Small Non-Road Engines (lawn equipment, generators)

- Emissions and Exhaust Temperature Pilot Study (6 engines)
 - Testing completed May 2008 – Report #1 published October 7, 2008
- Full Useful Life Emissions and Durability (17 / 22 engines aged to full life)
 - Testing completed May 2008 – Report #1 published October 7, 2008

DOE Results to Date: Vehicles



■ Emissions / temperature

- Regulated tailpipe emissions with E15 and E20 were similar to levels with E0.
 - NMHC and CO decreased slightly (CO flat from E10-E20).
 - Ethanol and acetaldehyde emissions increased as expected.
- Under most conditions, catalyst temperatures were largely unchanged with E15 and E20 compared to E0.
- Under full throttle conditions, about half of the cars exhibited increased catalyst temperatures with E15 and E20 compared to E0.

■ Drivability

- Drivability issues were not identified with either E15 or E20.
- No malfunction indicator lights or filter plugging.
- Informal observations only.

■ Fuel Economy

- Fuel economy on volumetric basis decreased for E10, E15, E20.
- Closely tracked fuel energy content.

DOE Results to Date: Small Engines



- Emissions / Temperature
 - With increasing ethanol content:
 - Regulated emissions – combined HC+NOx – decreased in most cases.
 - Engine and exhaust temperatures increased.
- Durability
 - Commercial engines, as well as more sophisticated residential engines, exhibited no particular sensitivity to ethanol from a durability perspective.
 - The effect of E15 and E20 on the durability of smaller, less expensive residential engines (e.g., leaf blowers) was not clear.
- Safety:
 - Potential issue: Increased ethanol caused spontaneous clutch engagement on tested commercial line trimmers (Note: Problem was fixable with carburetor adjustment.).



Vehicles

Tailpipe Emissions (with EPA)

- Phase 1 and 2 completed
- Phase 3 underway with results expected in February 2010

Full Useful Life Emissions Study (with CRC)

- Testing underway; Results expected 2010
- Testing variety of high volume models on E0, E10, E15, E20

Evaporative Emissions (with CRC and EPA)

- Project E-77-2b in initial stages; CRC Report expected in 2010

Fuel System Materials Compatibility (with CRC)

- Testing underway; Results expected by October 2009

Cold Start and Driveability (with CRC)

- Testing at high ambient temperature
- Tentative start and completion: Summer 2009

Other Engines/Infrastructure Components

Motorcycles, marine, snowmobiles, chain saws, dispensers, underground storage tanks