

Green Technology Connect Forum

Session 7: Biofuels

Next Generation Prospects, Barriers and Opportunities

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Biofuels: Driven by the Convergence of Air Quality, Climate & Energy Security



- South Coast Air Basin:
 - **25% of U.S. ozone exposure**
 - **50% of U.S. PM-10 exposure**
 - **> 85% of airborne cancer risk from petroleum fuel use (diesel + gasoline)**
- Transportation sources: > 40% of CA GHG
- Energy security:
 - CA Transportation: > 95% reliance on petroleum
 - 72% of U.S. oil supply is imported

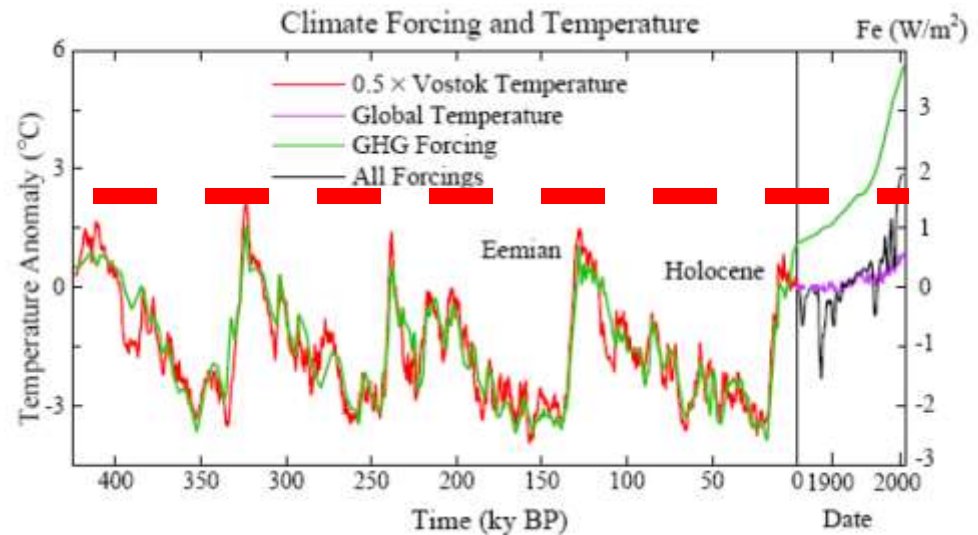
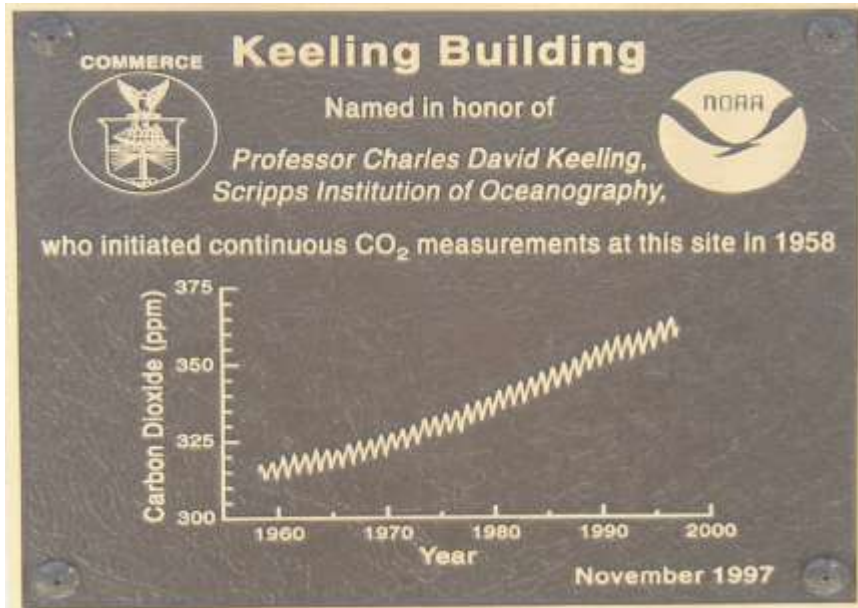
Biofuels:

A new American Idol?

- **Growing consensus that corn feedstocks are limited**
- **2nd and 3rd generation feedstocks and pathways appear to have lower GHG impacts**



Fossil Fuel Use: *Largest Atmospheric Experiment in History*



Source: James Hansen, 2008



California's Low Carbon Fuel Standard

- Carbon intensity performance standard
 - gCO₂e / MJ
 - **10% reduction** in gasoline CI: **95.61 → 86.27**
 - 10% reduction in diesel CI: **94.47 → 85.24**
- Adopted in April, 2009
- Based on “well-to-wheel” GHG accounting
- Significant roles for:
 - **Biofuels** (*especially non-corn ethanol*)
 - Electricity, natural gas, hydrogen all have GHG reduction potential



CA Biofuel Resource: Potentially Huge

- 1.5 B gasoline gallon equivalent from biochemical biofuels
 - 32 million bone dry tons per year
- 1.7 B diesel gallon equivalent from thermochemical biofuels
 - 32 MM BDT/yr
- Biomethane @ 106 BCF per year
- CO₂ to fuels?

Source: CEC



Biofuel Potential Benefits

- Reduced criteria and toxic emissions
- Reduced GHG emissions
- Mitigation of fossil resource depletion
- Capital investment in America
- Easily integrated with Electric Drive pathways
 - *E.g., P-HEVs with FFV capability*
- Liquid fuel handling similar to current bulk and retail infrastructure



Commercial Uncertainties

- Scale of the potential biofuel production
- Pace of R & D progress
 - Science barriers
 - Engineering optimization
- Commercialization pathways
 - Blend components
 - Neat fuel (e.g., E85, B100, etc.)
 - Fungibility considerations
- Business capitalization risk
 - *Traversing the "Valley of Death"...*



Specific Concerns & Questions

- No biofuel plant fits neatly into any of the scenarios modeled by CARB under LCFS
- Scale-up is very hard to predict:
 - Pilot: 1 tpd
 - Pre-commercial: 50 tpd
 - Commercial scale: 1,000 tpd
- How can GHG estimates for 2nd gen plants reflect bulk handling and transport emissions?
 - *How do we estimate bulk shredding, pelletizing, briquette production, etc. when no such large scale plants are in operation?*

What is the Appropriate Holistic Perspective?



- Corn acreage now estimate at 87 million acres by USDA
 - 2nd Highest since 1946
- Texas is experiencing the worst drought in 50 years
- Indirect land use effects are inherently hard to model and verify
- The E10 “blend wall” means different problems for different constituencies...
- Without an FFV mandate, why pursue E85?
- Specifications for biodiesel are still evolving...
 - NOx impacts still of concern
- Current gasoline certification fuels create a false sense of baseline
 - Some PZEVs would not qualify using retail gasoline with E10

What We'll Hear today:

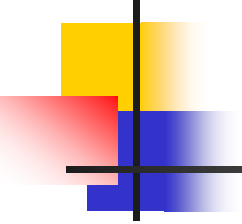


- Propel:
 - Retail stations network providing E85, B20, and other options;
- GRT
 - Conversion of biomethane to gasoline via bromine activation;
- Firm Green
 - Conversion of LFG to CNG and LNG for vehicle applications;
- Fulcrum BioEnergy
 - Conversion of MSW to ethanol via plasma technology;
- Microgy,
 - Anaerobic digester (largest in the world) providing renewable NG;
- Primafuel,
 - One of the largest algae bioreactors in the world.



Opportunities Going Forward

- AQMD region a fertile market for wide range of demonstrations
- Anticipated growth in biofuel-compatible vehicles
- CA energy market price trends favor alternative fuels
- LCFS Compliance advantages possible
- AQMP + AB 32 Action Plan support biofuel commercialization



"So do not assume it's impossible because you find it hard, but recognize if it's humanly possible, you can do it too !"

Marcus Aurelius

Thank you for your interest !



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