Meeting Agenda

• Introductions
• Presentation from University of California, Davis
• Fuel Pathways
  – Methodology of Energy and GHG Emissions Calculations
  – Overview of Completed Pathways and Carbon Intensity (CI) Values
• Discussion
• Future Fuel Pathways
• Other Stakeholder Presentations
• Lunch Break
Fuel Pathways
Well-to-Wheel (WTW) Analysis

- ULSD
- CaRFG
  - CARBOB
  - Corn Ethanol
- CNG
- Electricity

General Flowchart of Well-to-Wheel Analysis

- **WTT**: Feedstock and fuel production, transportation, and distribution
- **TTW**: Vehicle operation
**General Notes about the Pathways (1)**

- Very specific scenario for each document
- GREET methodology included in all pathways
- Input values have been changed for CA where appropriate
  - crude recovery efficiency
  - electricity mix
  - etc.
- Model does NOT include vehicle adjustment factor

**General Notes about the Pathways (2)**

- Modifications made to input values could have led to values being different from AB 1007 or UC Reports
- All values preliminary at this point
- Stakeholders encouraged to review and comment
Methodology of Energy and GHG Emissions Calculations

**Energy Calculation Methodology**

- Fuel Shares: Amount of energy resource consumed during the production, transportation, processing, and distribution of a transportation fuel

- Btu/mmBtu: Calculated Btu of energy needed to produce one million Btu of the indicated fuel output

- Numbers still being refined
**GHG Emissions Calculation Methodology**

- GREET includes: CO$_2$, CO, VOC, CH$_4$, and N$_2$O
  - CO, VOC converted to CO$_2$ in a short time in atmosphere
  - CH$_4$, N$_2$O are IPCC recognized GHG gases

- Carbon Intensity (CI) reported in gCO$_2$e/MJ

- GHG calculated in g/mile and converted to gCO$_2$e/MJ
  - For CO$_2$, CO, VOC: based on carbon content in the fuel and its density.
  - For CH$_4$, and N$_2$O: based on California Climate Action Registry (CCAR) emission factors (g/mile)

**Land Use**

- Land Use (direct and indirect) not included
Vehicle Adjustment Factor

- LCFS will include a vehicle adjustment factor
- Recognize that some vehicles and fuel have better efficiencies
- Still determining appropriate adjustment factors
Fuel Pathways

Overview of ULSD Pathway

Crude Recovery

Crude Transportation

Crude Refining

ULSD Transportation

Storage Terminal

Transportation To Pump

Vehicle (carbon in fuel)

Fuel Station

Diesel 99.4 (gCO₂e/MJ)
ULSD
%GHG Emission Contributions

Vehicle CH₄ & N₂O 5.1%
Crude Recovery 7%
Crude Transport 2.3%
Crude Refining 11%
ULSD T&D 0.3%
Carbon in Fuel 74%

Diesel 99.4
(gCO₂e/MJ)

General Notes about ULSD

- Considers CA average crude mix refined in CA
- UC reported values of CI of 91 but here CI ~99
- Tailpipe N₂O and CH₄ included
- Crude recovery includes CA heavy crude recovery
- Preliminary at this point
- To illustrate GREET embedded methodology
- Stakeholders encouraged to review and comment
Overview for CaRFG Pathway

CARBOB 95.2 (gCO₂e/MJ)

Ethanol 76.5 (gCO₂e/MJ)

CaRFG %GHG Emission Contributions

- Vehicle CH₄ & N₂O: 2.3%
- Crude Recovery & Corn Production: 8.2%
- Crude & Corn Transportation: 2.3%
- Crude Refining & Ethanol Production: 14%
- CARBOB & Ethanol T&D: 0.4%
- Carbon in Fuel: 73%
Overview for Electricity Pathway

Resources include: natural gas, coal, other (includes wind, hydro, etc.) uranium, biomass, and residual oil.

Electricity Production

%GHG Emission Contributions

- Coal 48%
- Natural Gas 51%
- Biomass 0.1%
- Nuclear 0.3%
- Residual Oil 0.1%

Hydro, Geothermal, Wind, and Solar contribute negligibly to GHG emissions.
Overview for CNG

CNG

%GHG Emission Contributions

CNG 67.9 (gCO₂e/MJ)

Vehicle CH₄ & N₂O 3.7%
Natural Gas Recovery 4.8%
Natural Gas Processing 5.3%
Natural Gas Transportation 1.7%
Carbon in Fuel 81%
**Future Pathways**

- Biodiesel
- LNG
- Cellulosic Ethanol
- Hydrogen
- Renewable Diesel
- Propane
- Bio-methane
- Coal-to-Liquid
- Gas-to-Liquid
- Oil Sands

*Others?*

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**Future Work on Pathways**

- Review stakeholder comments and update if necessary
- Incorporate aspects of GREET 1.8b into CA version
- Provide updated CA-GREET model
- Review current input values and update if appropriate
- Detail additional pathways as needed
Tentative Working Group Meeting

- Next Lifecycle Analysis Working Group Meeting

  Proposed: June 16, 2008

  See LCFS website for details