



Transportation Fuel-Cycle Analysis: What Can the GREET Model Do?

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U.S. Environmental Protection Agency

Fuel-Cycle Modeling Workshop

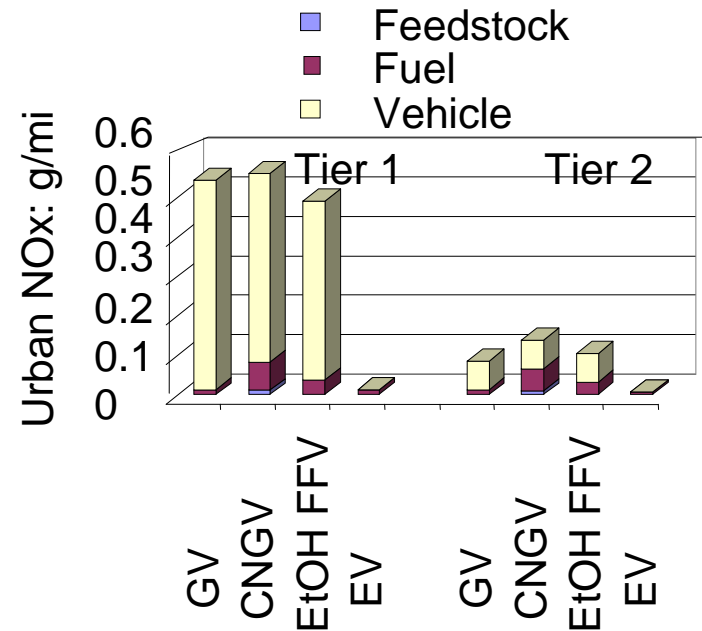
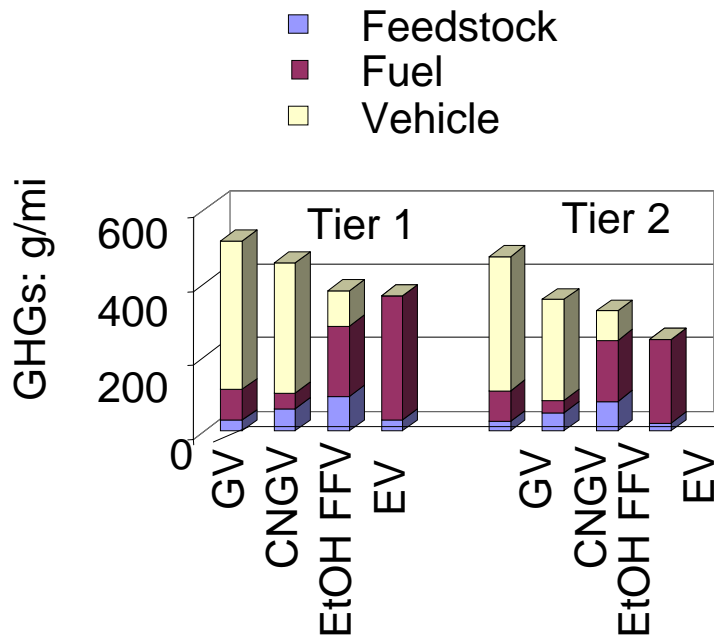
Louisville, KY

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Fuel-Cycle Analysis Becomes Necessary When Comparing Different Fuels

- Upstream emissions vary considerably among different fuels
- As tailpipe emissions are tightened, upstream emissions will become a major source



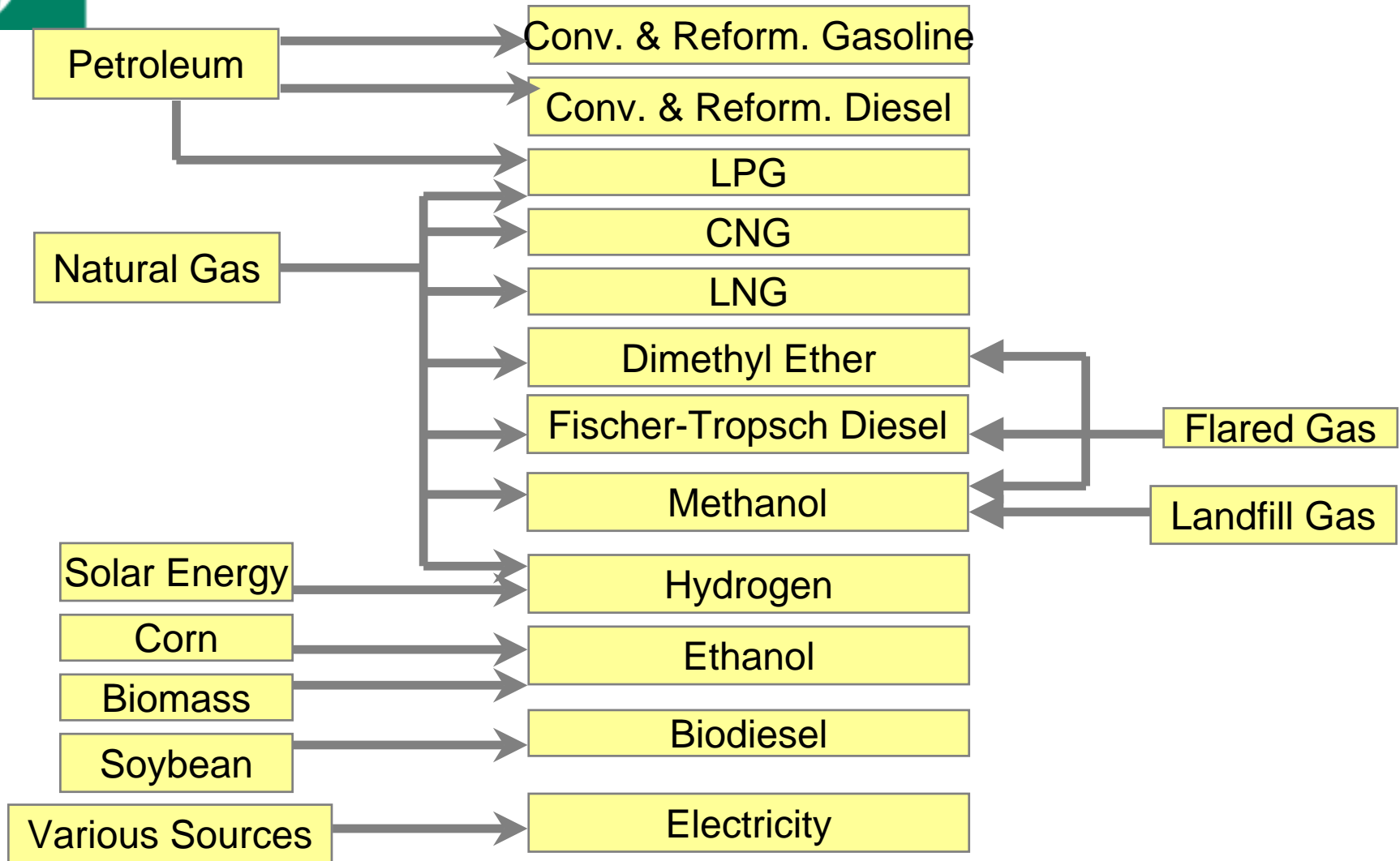


GREET Estimates Per-Mile Energy Use and Emissions Rates

- Emissions of greenhouse gases (weighed together with GWPs):
 - CO₂, CH₄, and N₂O
 - VOC, CO, and NO_x as optional GHGs
- Energy use:
 - All energy sources
 - Fossil fuels
 - Petroleum
- Emissions of five criteria pollutants (total and urban separately):
 - VOC, CO, NO_x, PM₁₀, and SO_x



REET1.4a Includes More Than 30 Fuel Cycle Pathways





GREET1.4a Includes More Than 50 Near- and Long-Term Vehicle Technologies

Conv. SI Vehicles

- CG, RFG
- CNG: dual-fuel, dedicated
- LNG, LPG
- MeOH, EtOH: FFVs, dedicated

SIDI Vehicles

- RFG
- CNG: dedicated
- LNG, LPG
- MeOH, EtOH: dedicated

CIDI Vehicles

- CD and RFD
- DME
- FTD
- Biodiesel

Other Vehicles

- Battery-powered EVs
- HEVs: CIDI and SIDI engines
 - grid independent
 - grid connected
- FCVs: H₂, gasoline, MeOH, EtOH



GREET, Mobile5, and Part5: GREET Uses Outputs from Both Models

- Vehicular emissions of baseline gasoline and diesel vehicles:
 - HC, CO, NO_x, and CH₄ from Mobile5
 - PM10 from Part5
- AFV emission changes are estimated with their emission testing results and technology potentials
 - SI AFV emissions relative to gasoline vehicles
 - CI AFV emissions relative to diesel vehicles
- SO_x emissions are calculated from sulfur content of fuels
- CO₂ emissions are estimated from carbon balance
- N₂O emissions are assumed with emission testing results and technology potentials



DOE/OTT Has Been a Major Sponsor of GREET Development

- GREET sponsors include
 - OTT's Planning and Assessments (P. Patterson)
 - OTT's Office of Technology Utilization (D. Rodgers)
 - State of Illinois (DCCA, D. Loos)
- GREET1.4a status:
 - Draft report was completed last fall, and comments were received winter 1998
 - Final report and model will be completed summer 1999
- GREET1.0 report and GREET1.4 model are available at www.transportation.anl.gov/ttrdc/publications/

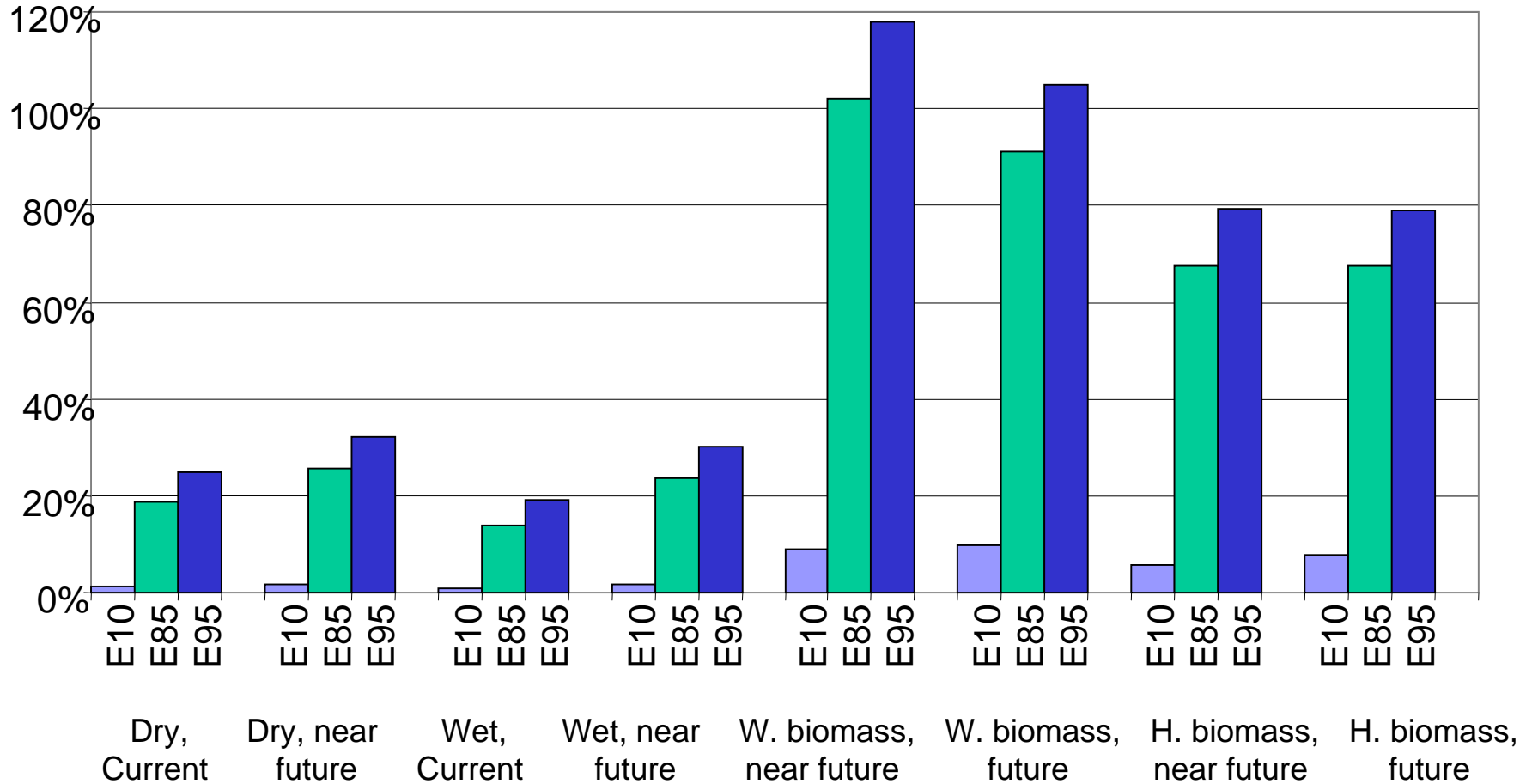


GREET Applications for Evaluations of Individual Industries

- Corn-based ethanol
 - Study conducted for the state of Illinois in 1997
 - Follow-up study was completed for DOE in 01/99 (report available from the AFV Hotline)
- Natural gas-based fuels
 - Draft report now under review
 - Final report to be out in 07/99
- EPRI is to recommend an EV-friendly GREET version to electric utility companies

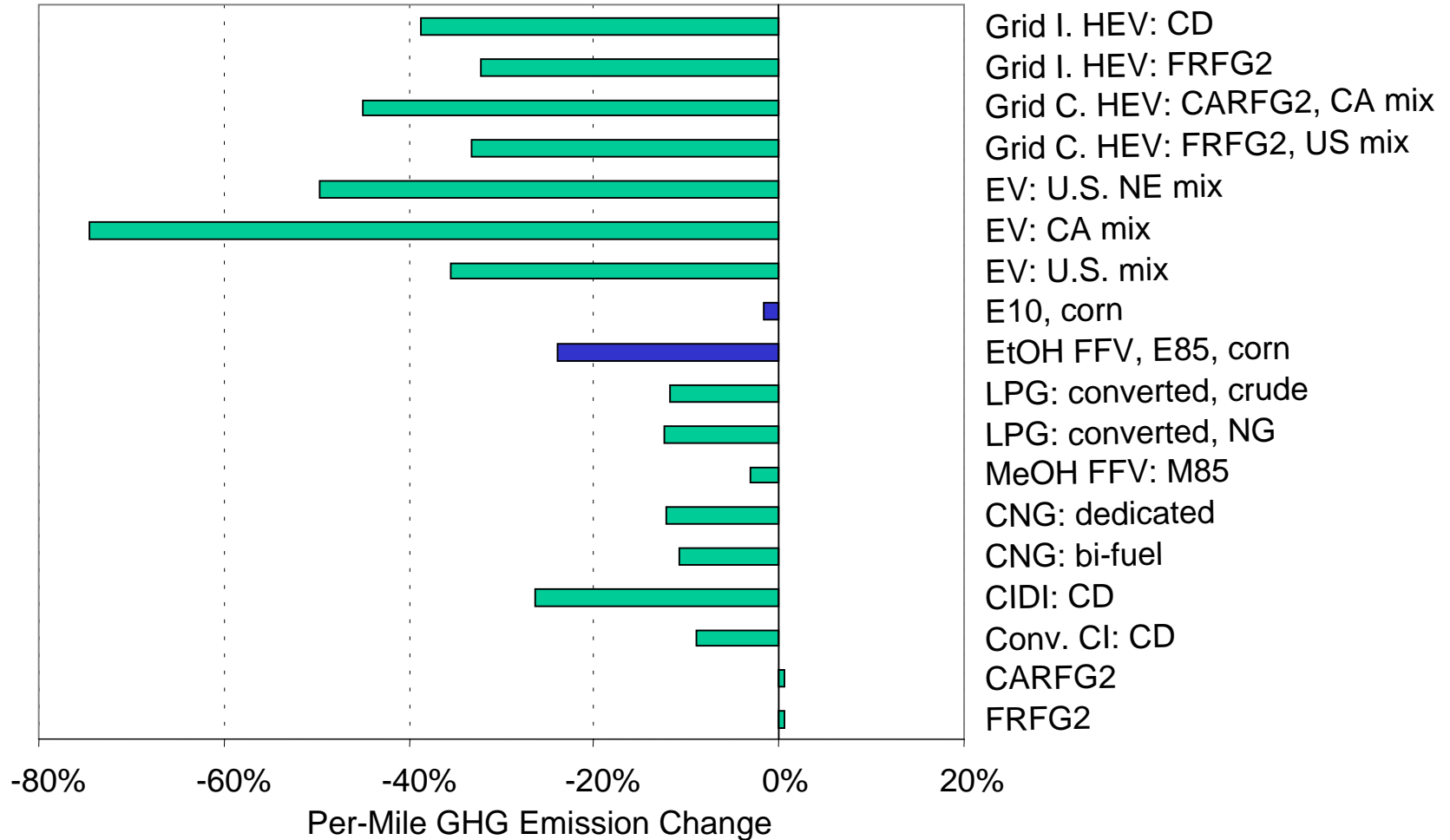


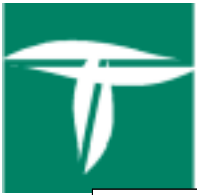
Per-Mile GHG Emissions Reductions by Ethanol Blends (Relative to Gasoline)



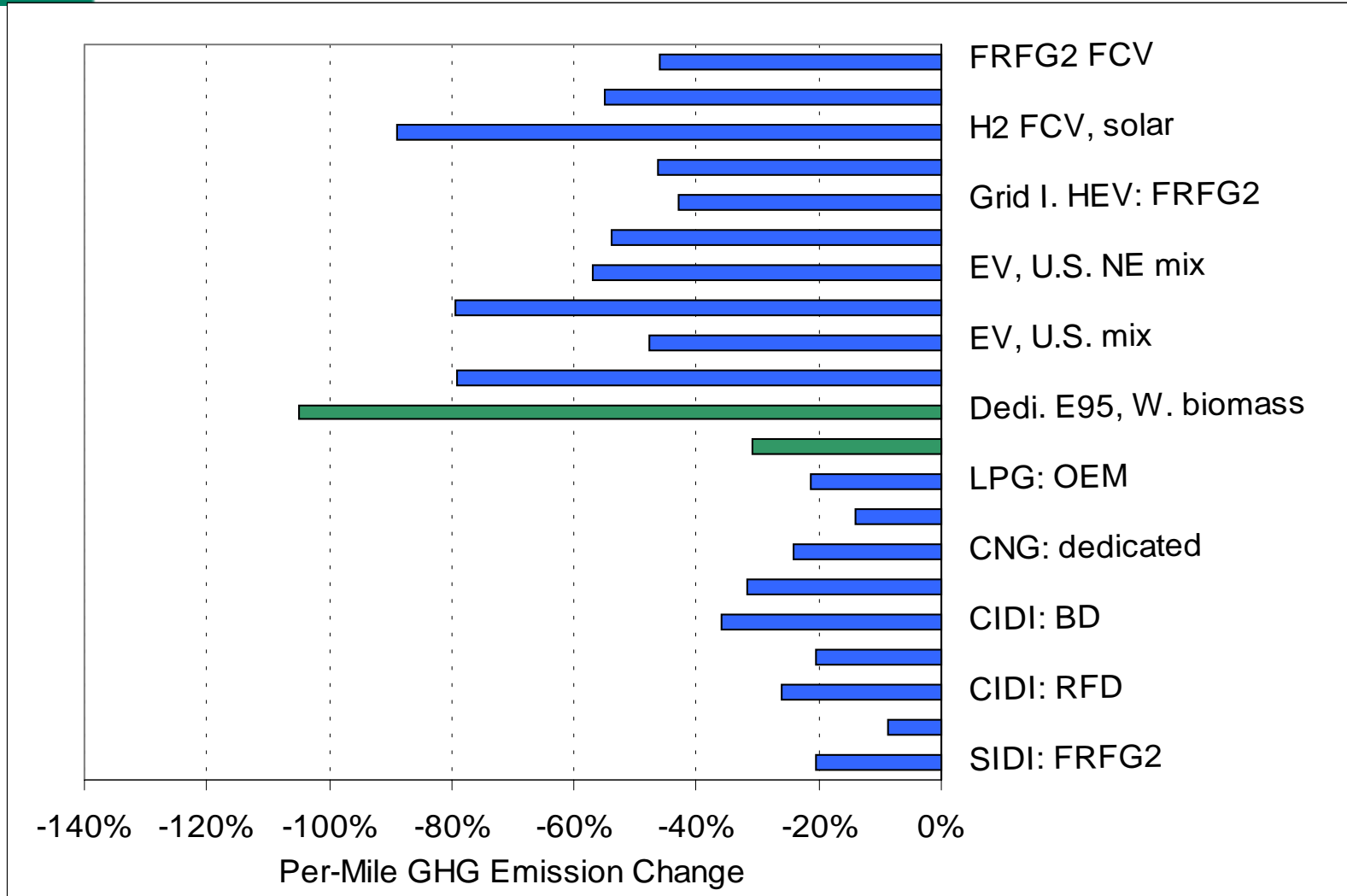


Per-Mile GHG Emission Changes: Near-Term Cars (Relative to Tier 1 GV)





Per-Mile GHG Emission Changes: Long-Term Cars (Relative to Tier 2 GVs)





Ongoing Development Efforts

- Add air toxic emissions to GREET
- Revise key assumptions regarding upstream fuel production activities and vehicle operations
- Include additional fuel-cycle pathways and vehicle technologies, as appropriate
- Explore ways to address uncertainties in GREET simulations



Efforts Are Needed to Make GREET a Facility-Specific Model

- Industry-average data in the current GREET version need to be revised to facility-specific data
- Pathway boundary for a simulated facility need to be defined
- Clear guidance on using industry-average vs. facility-specific data is needed
- A mechanism for fuel producers to predict emissions of future facilities is needed
- Vehicular fuel economy and emissions cannot be ignored completely