U.S. DEPARTMENT OF ENERGY

Session VIII: How Will Advanced Biofuels Move Forward?

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Rethinking Energy and Climate Strategies for Transportation

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Changing Motivations for U.S. Alternative Fuel Policies

- Alternative fuels have been promoted for different policy reasons.
- During the 70's they were advocated to reduce oil import dependence.
- During the 80's they were advocated to reduce urban air emissions.
- During the 90's to the present time they are advocated to reduce CO_2 emissions.
- And they are again advocated to reduce oil dependence & increase fuel diversity.

Alternative Fuels Did Help Reduce Urban Air Pollution

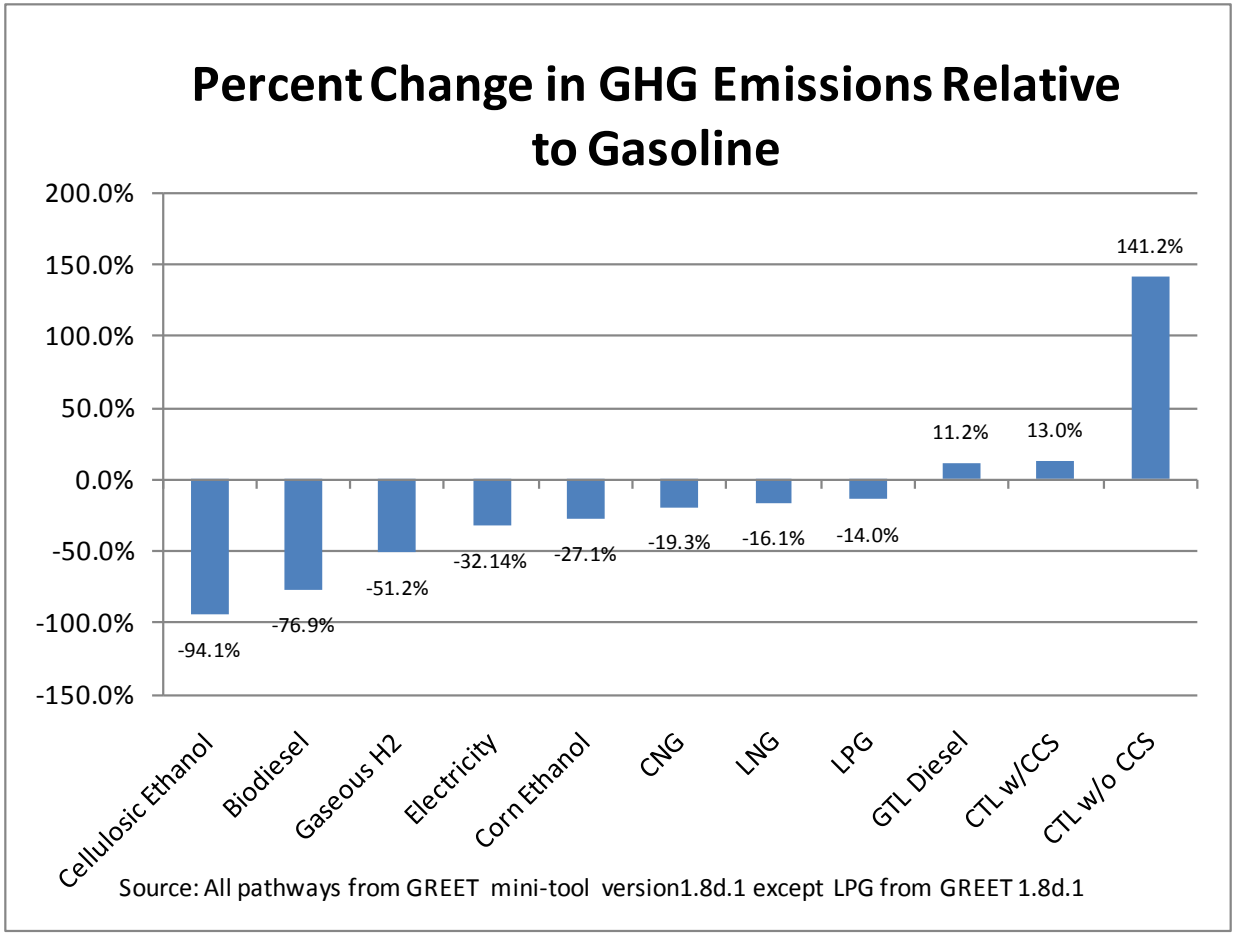
- **Alternative fuels never achieved traction as a way to reduce urban air pollution except in heavy duty fleet vehicles (e.g., urban buses running on natural gas).**
- **However, they forced the refining and the automobile industries to agree to more stringent pollution regulations (Clean Air Act Amendments of 1990).**
- **As a result, current light-duty vehicles produce very low emissions (apart from CO_2).**
- **A zero-emission vehicle would provide very low urban air quality benefits compared to a current conventional vehicle.**

Urban Pollution vs. GHG Emissions

	Air Quality Value	GHG Value
Annual Value ($)	**17**	**150**
Life-Cycle Value[c]	**170**	**1,500**

[c] Assumes 120,000 miles/vehicle and 10 year vehicle life

What Alternative Fuels Achieve Low GHG Emissions?



Alternative Fuels in Order of GHG Reduction Potential – Current Status

- **Cellulosic Biofuels:** Rapid expansion required by the 2007 Energy Independence and Security Act (EISA). However, requirements have been waived due to delays in commercial production.
- **Biodiesel:** Also required by EISA but feed stocks are very limited. Controversy over food vs. fuel and lower GHG reduction rank if indirect GHG emissions are counted.
- **H_2:** Faces substantial technology development & infrastructure challenges. Least expensive source of H_2 is natural gas. Deeper CO_2 reductions will require another feedstock. A fuel for the future.
- **Electricity:** Infrastructure mostly in place. Plug-in hybrid vehicles eliminate range and refueling obstacles to broad market acceptance. Potential to move up on the GHG savings scale as the power sector is de-carbonized. Commercial production has commenced (e.g., Chevy Volt and Nissan Leaf).
- **CNG/LNG:** Best for fleets; infrastructure/attribute issues for motorists.
- **Corn Ethanol:** Already important but controversy over food vs. fuel and indirect GHG emissions. EISA “limits” corn ethanol to 15 billion gallons.

The Promise of Cellulosic Biofuels

- **Cellulosic Biofuels offer, by far, the greatest per gallon reduction in GHG emissions.**
- **These emission reductions do not depend on major transformations of other elements of the energy economy, for example, decarbonization of the power sector.**
- **Federal mandates are already in place to encourage their production and require their use (if available).**
- **So why are cellulosic biofuels stalled?**
- **And what can we do about it?**

Speakers

- **Thomas Foust** (National Renewable Energy Laboratory), "*Status of Cellulosic Biofuel Commercialization*"
- **Ruth Scotti** (BP), *"Commercializing Cellulosic Biofuels"*
- **John Kneiss** (Hart Energy Publishing), *"Is the Renewable Fuel Standard Sufficient to Motivate Cellulosic Biofuel Production?"*
- **Jeremy Martin** (Union of Concerned Scientists), *"How Do We Get Biofuels Back on Track?"*
- **Kinkead Reiling** (Amyris Technologies), *lead discussant*
- **Discussion**

Appendix: Air Pollution vs. GHG Emissions Calculations

- **Urban Pollution: Value of Regulated Emissions**
- **GHG Emissions: Value of GHG Emissions**
- **Urban Pollution vs. GHG Emissions**

Urban Pollution: Value of Regulated Emissions

	NOx	VOC	CO	PM
Tier II Vehicle (bin 5) (gpm)	0.07	0.090	4.2	0.01
Emissions/Year[a] (tons)	0.0008	0.001	0.025	0.00012
Emission Value ($/ton)	13,000	5,000	-[b]	10,000
Annual Value ($)	11	5	-	1

[a] assumes 12k miles/year per vehicle

[b] CO emissions reductions are met through the application of the VOC (NMOC) emissions standard.

GHG Emissions: Value of GHG Emissions

	CH4	CO2
2016 LD Vehicle GHG Standards (gpm)	0.03	250
Emissions/Year (tons)	0.0004	3.0
Emission Value ($/ton)	1167	50
Annual Value ($)	0.4	150

Urban Pollution vs. GHG Emissions

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