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Role of Biofuels in Emission Reduction Strategies

Environment and Energy Study Institute
Rural Communities, Climate, and COVID-19 Recovery Briefing

Stefan Unnasch

Outline

- Biofuels and Air Quality Impacts
- GHG Reductions
- Policies for Rural Development

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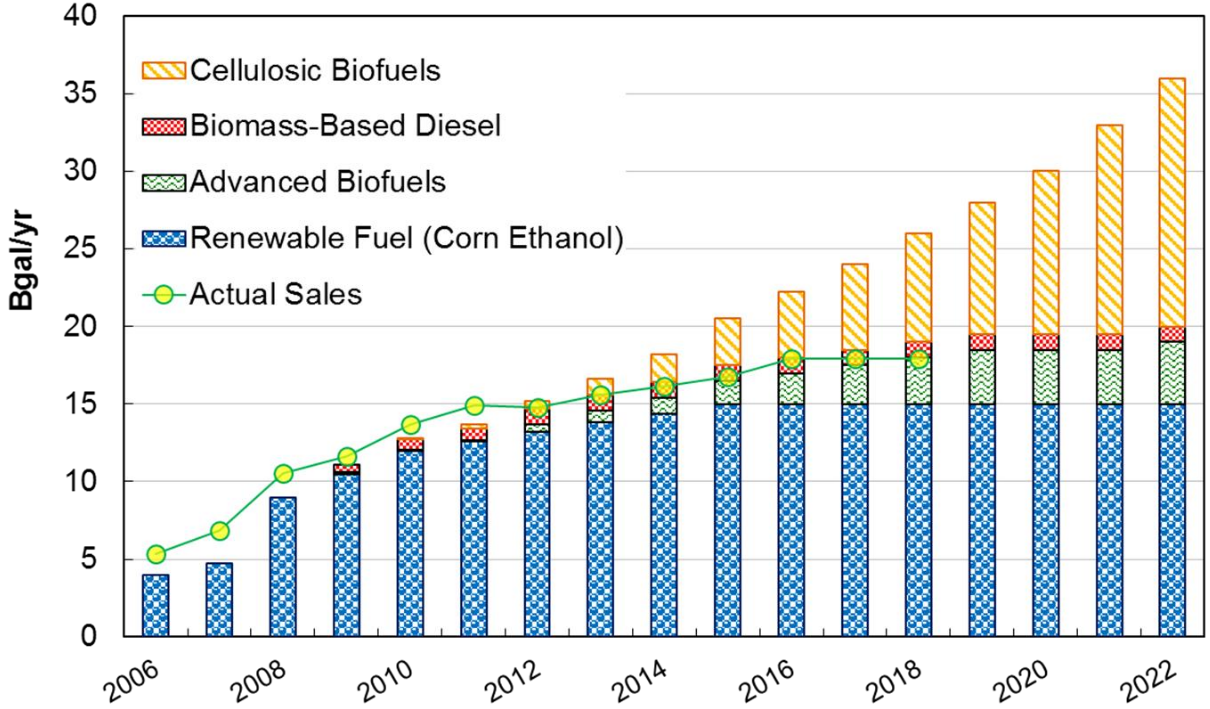
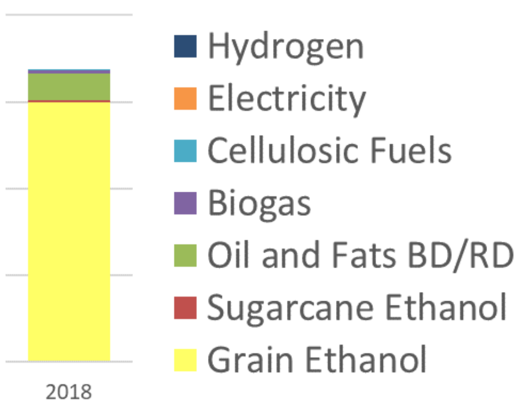
Alternative Fuels and RFS

- Biofuels have not kept pace with RFS expectation but still provide benefits.





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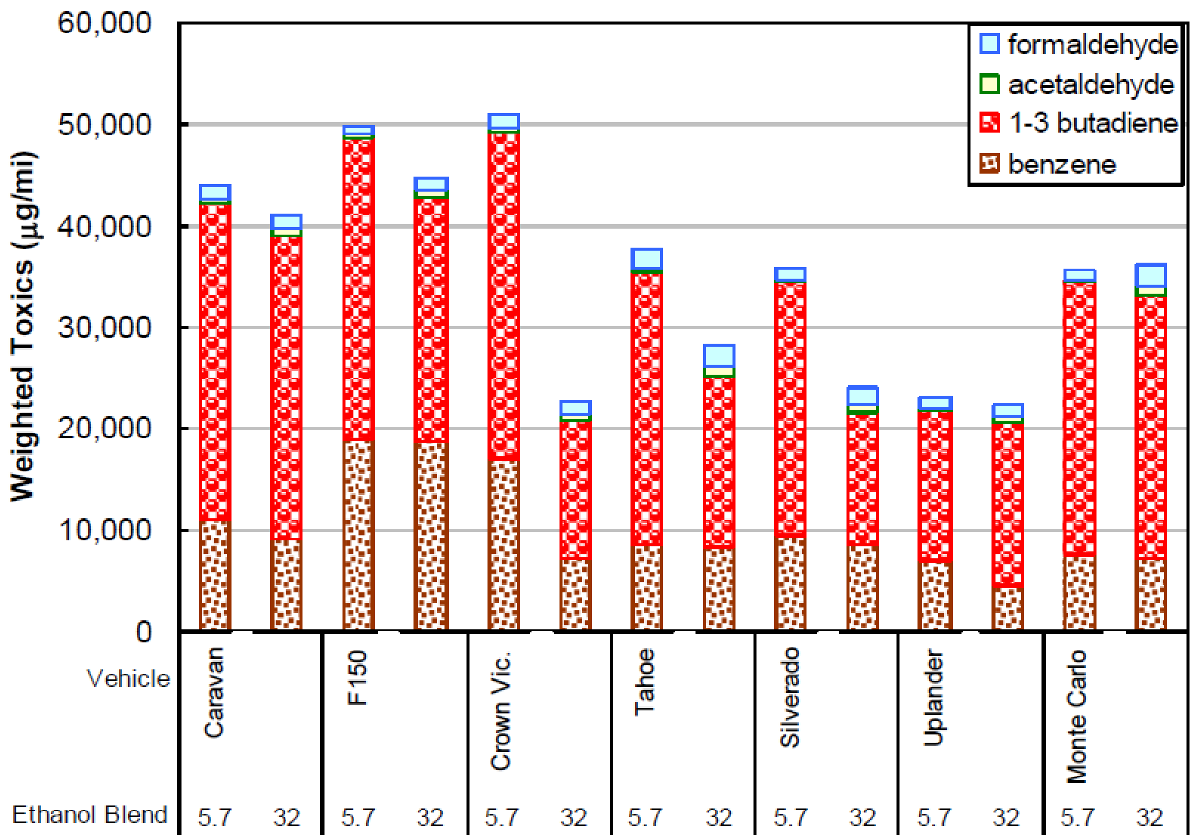
Fuel Properties and Air Quality

- Ethanol
  - High Octane Number: 99 (R+M)/2
  - Heat of vaporization, low sulfur, distillation properties
- Renewable Diesel
  - High Cetane Number: ~ 80
  - Low sulfur, no aromatics
- Biodiesel
- Biogas
  - Avoids flaring, dairy lagoons
- Electricity & Hydrogen: ZEV

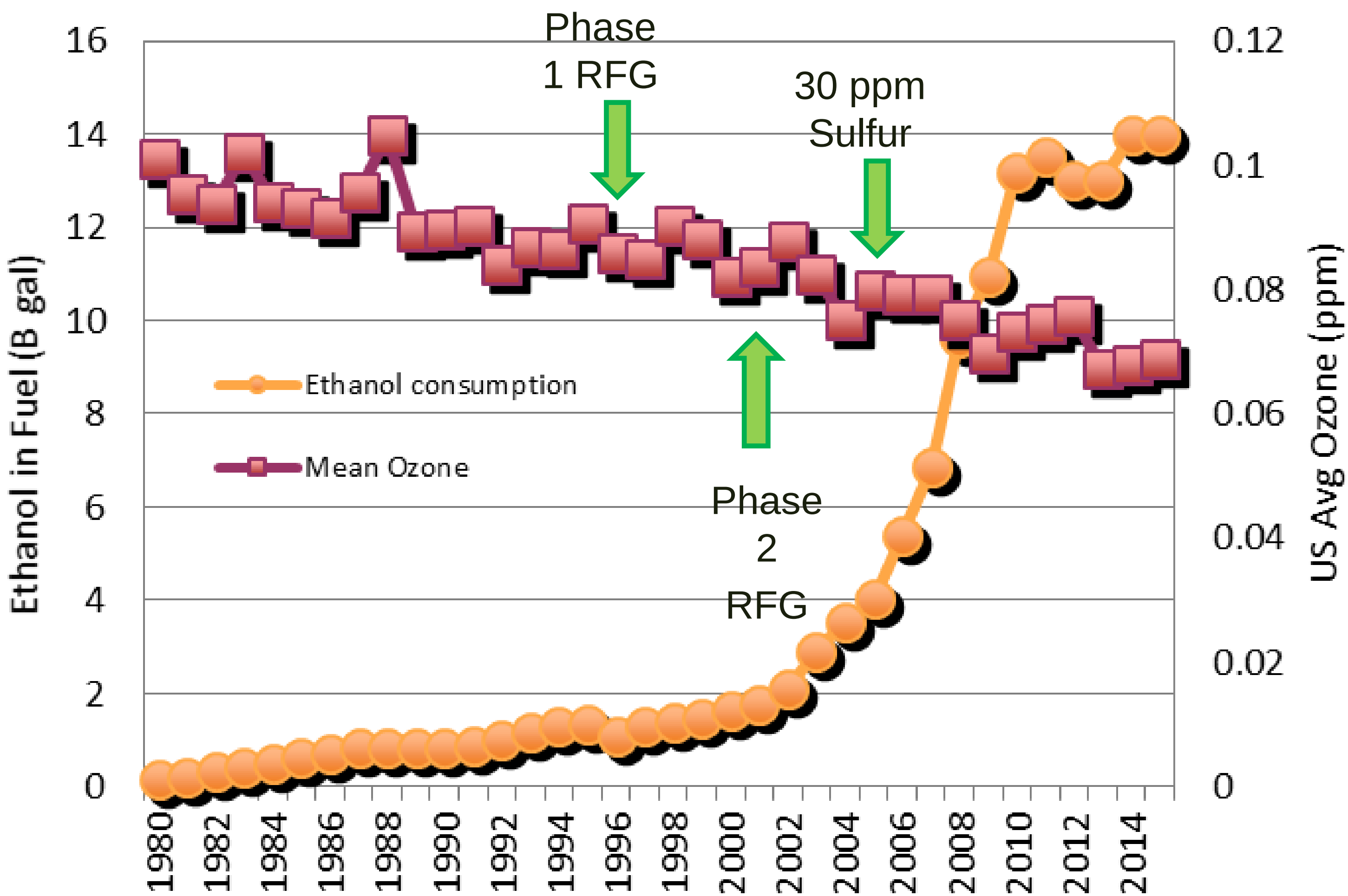
Ethanol Blends and Air Toxics

- Aromatics
- T50
- T90
- Benzene
- Sulfur

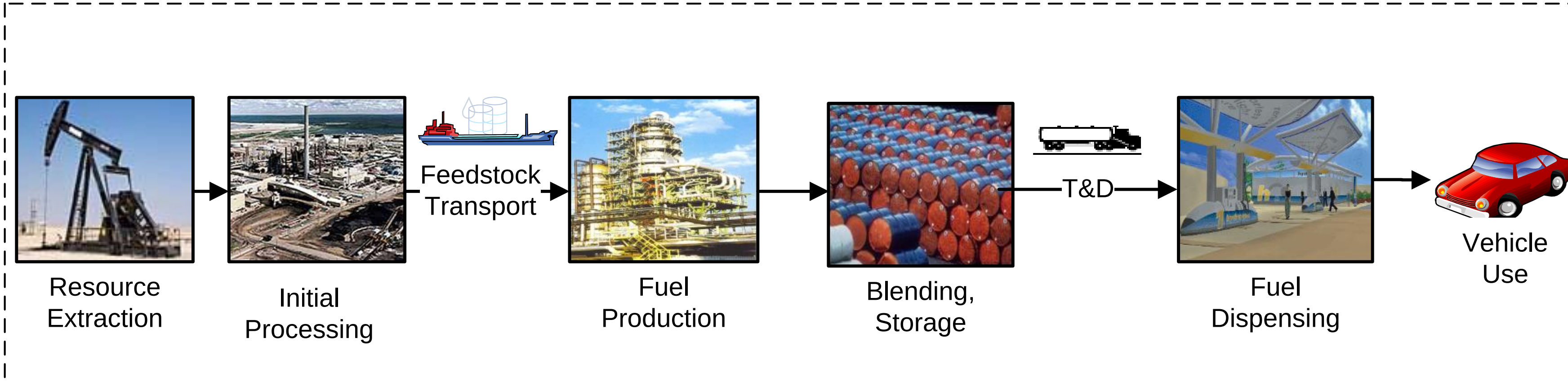


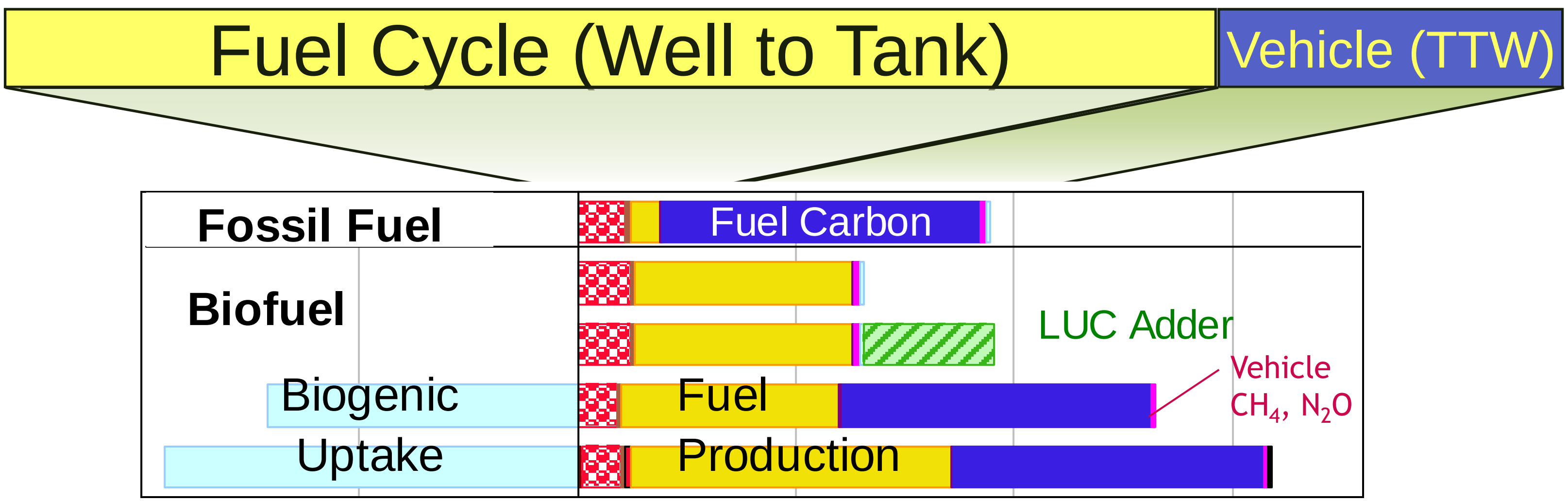
Source: Unnasch, S. and A. Henderson, (2014). Air Quality Impacts Associated with the Use of E15 Blends Instead of E10. Life Cycle Associates Report LCA.6091.94.2014. Prepared for Americans United for Change.

U.S. Ozone Levels



Life Cycle Steps and Carbon Intensity





Well to Wheel: WTW = WTT + TTW (g/mi)

Fuel CI: = WTT + Fuel Carbon + Vehicle CH_4, N_2O (g CO_2e/MJ)

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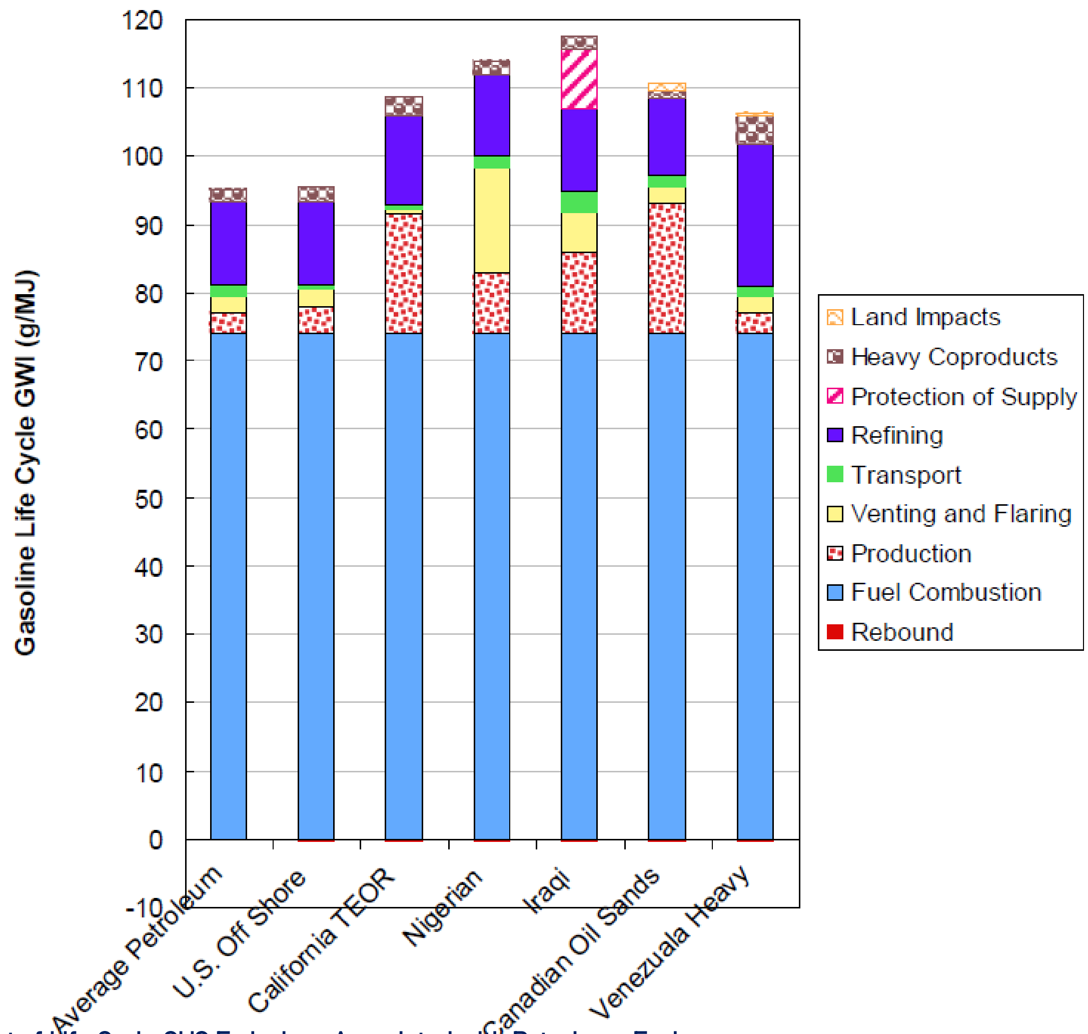
GHG Emissions from Petroleum Fuels

- Growth in unconventional sources
- Supply volatility
- Complex refining



Source: Unnasch, S. et al. (2009) Assessment of Life Cycle GHG Emissions Associated with Petroleum Fuels. Life Cycle Associates Report LCA-6004-3P, prepared for New Fuels Alliance.

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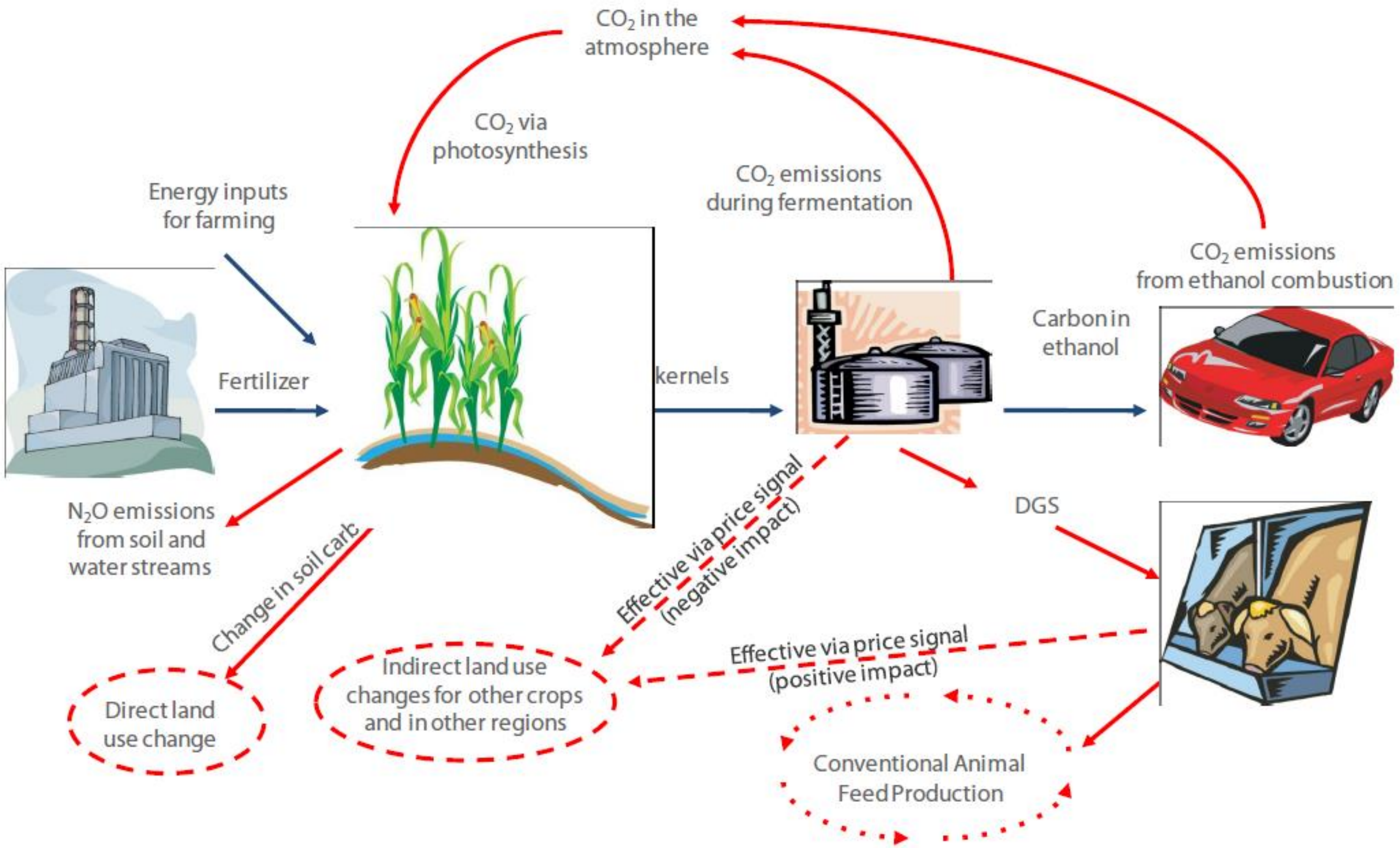
System Boundary – Corn Ethanol



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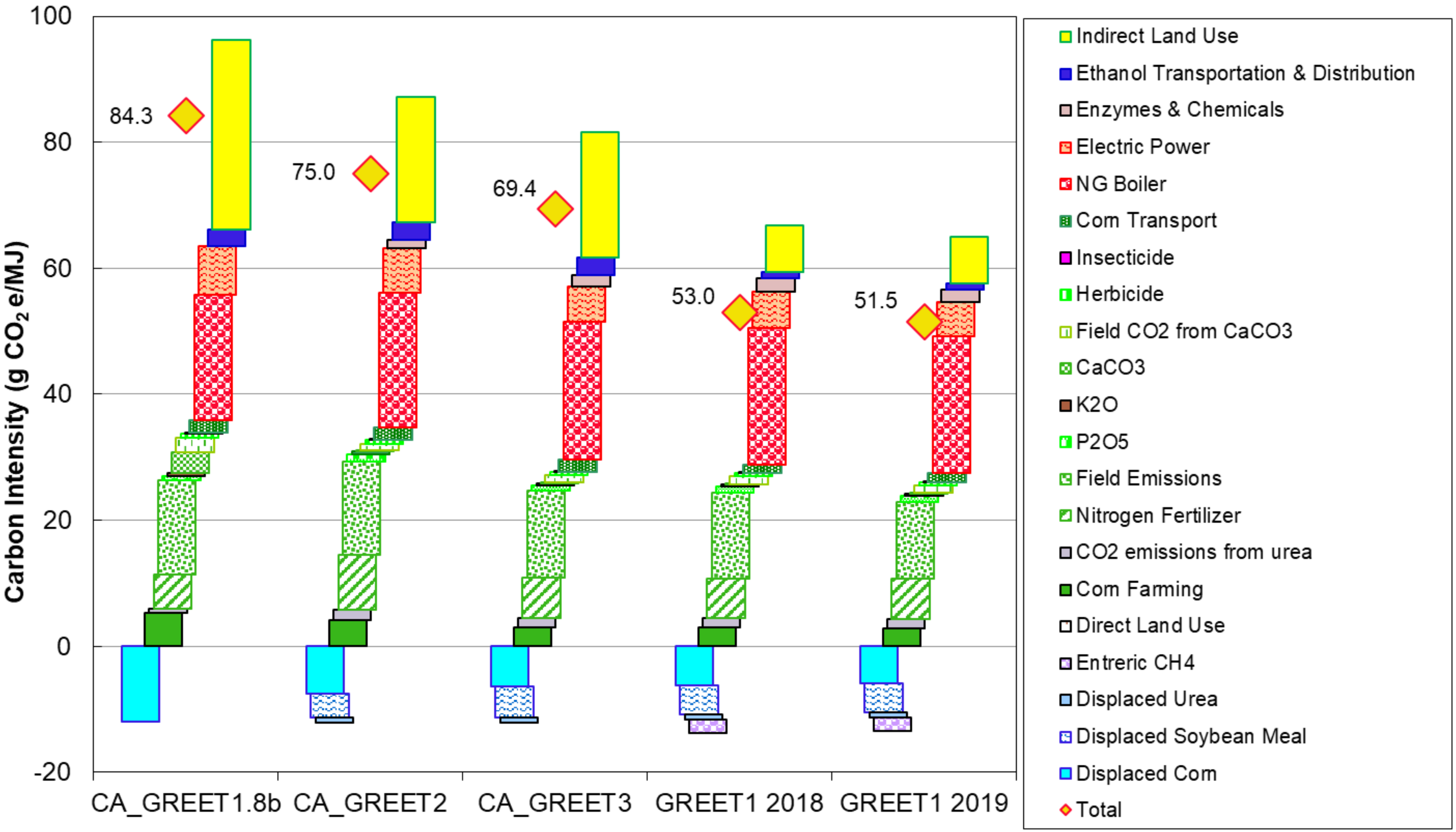
Evolution of Corn GHG Analysis



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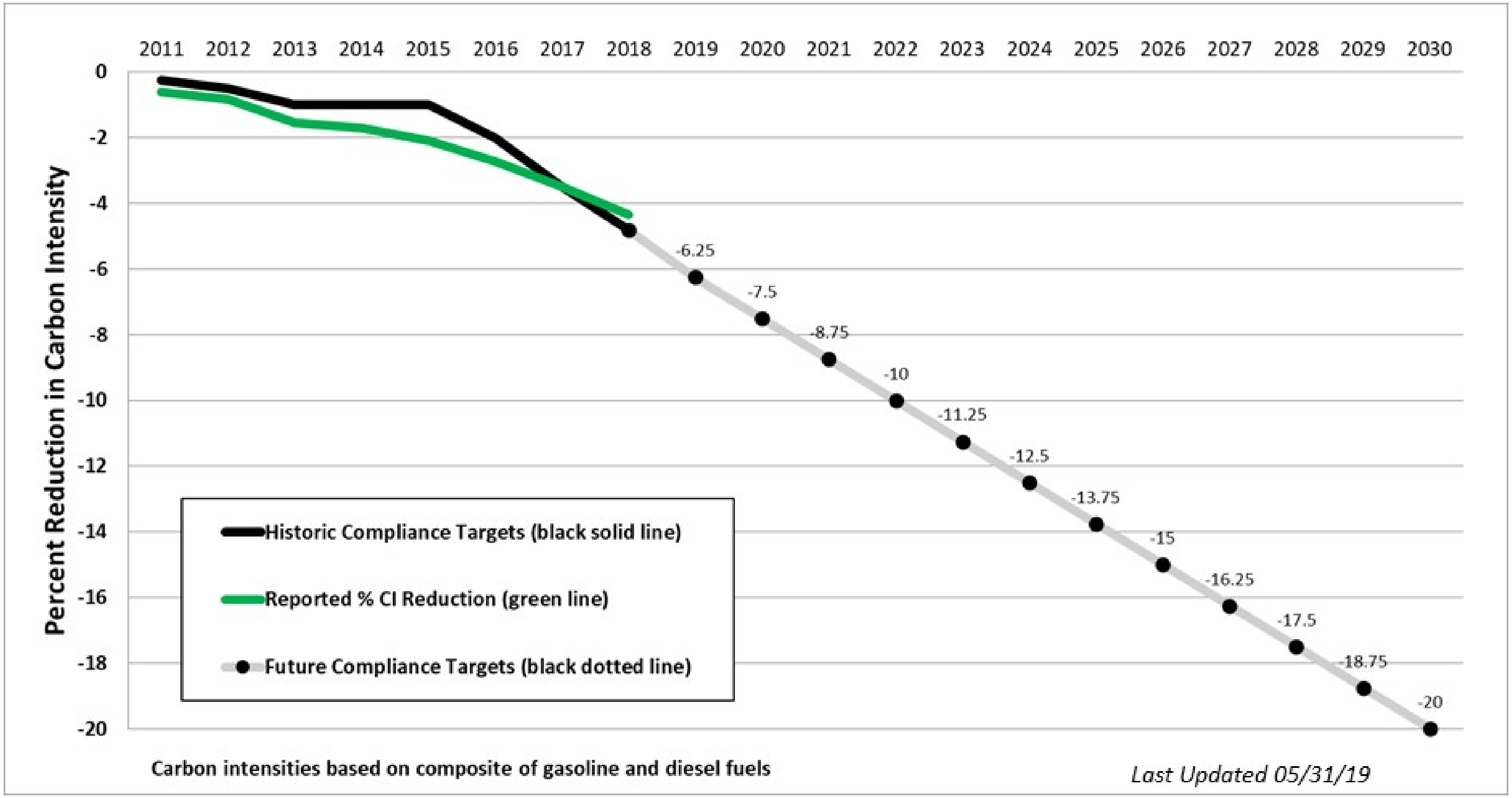
Why have a low carbon fuel program?

- Transportation is a significant portion of GHG emissions.
- Why not rely on Cap and Trade and Fuel Efficiency?
  - How to count EV GHG emissions?
  - Limited consumer incentive
- Many opportunities exist for innovation in transportation.
  - Low carbon fuels
    - Ethanol, Biodiesel, Renewable Diesel, Biogas, FT diesel, etc.
  - Electric vehicles: Battery, E85 PHEV, Hydrogen

2011-2018 Performance of the Low Carbon Fuel Standard

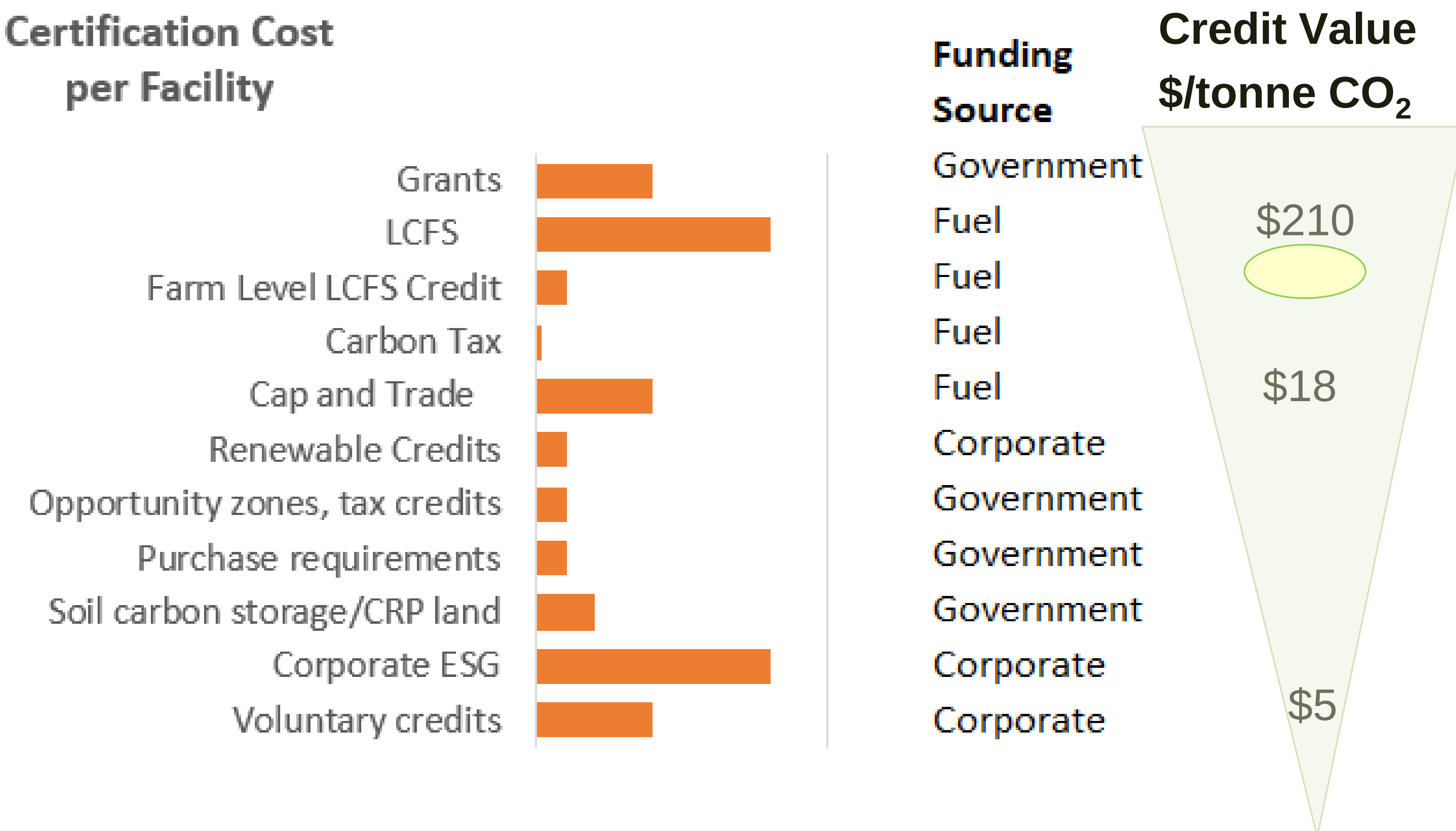


This figure shows the percent reduction in the carbon intensity (CI) of California's transportation fuel pool. The LCFS target is to achieve a 20% reduction by 2030 by setting a declining annual target, or compliance standard. The compliance standard was frozen at 1% reduction from 2013-2015 due to legal challenges, contributing to a build-up of banked credits as regulated parties bringing new alternative fuels to market continued to over-comply with the standard. The program will continue post 2030 at a to be determined stringency.

GHG Reduction for Rural America

Activity	GHG Savings	Utilization Options
No till farming	Reduce soil disturbance and enable build-up of soil carbon.	Corn Ethanol, Switchgrass Biofuel, Oilseed Diesel.
Reduced input farming. N_2O inhibitors.	Reduced emissions from fertilizer production and N_2O from fields.	
Energy crops	Soil carbon storage from perennial roots. Absorb nutrients from run-off.	Biogas, Ethanol, Jet Fuel, Hydrogen, Electricity, Pellet Fuel, Bio Chemicals, Bio Materials.
Manure and waste utilization	Divert wastes from generating methane and N_2O.	
Crop and forest residue utilization	Provide carbon neutral feedstock. Avoid decomposition in fields. Return nutrients as fertilizer.	
Prairie and forest restoration, Buffalo trace, Habitat zone	Provide opportunity for soil carbon storage on land associated with crop production. Absorb nutrients from run-off.	Corn and soy margins. Assign land to biofuel production.

Complexity and Value for GHG programs



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Lessons Learned from Fuel Programs

- Equity in GHG Reductions
  - Credits tied to GHG reductions
  - Flexibility in adopting new technologies
- Confidence for Investors
  - Losses in solar energy projects
  - Changes in RFS volume
  - Persistence in LCFS targets and price
- Technology Adoption
  - Biogas to RNG
  - Tallow to renewable diesel
  - Investments in cellulosic technology
  - Investments in electrification

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Suggestions for the Future

- Support E15.
- Bring back the flexible fuel vehicle.
  - As a high octane plug in hybrid
- Add RIN pathways for hydrogen and electricity.
- Develop biomass based jet fuel from residues.
- Enable innovation.
  - Manure by wire for biorefineries
- Support farm level benefits.
  - Low emission farming
  - Habitat restoration

LEE ENTERPRISES CONSULTING, INC.

Contact Information

Stefan Unnasch
Life Cycle Associates, LLC
office: 1.650.461.9048
mobile: 1.650.380.9504

unnasch@LifeCycleAssociates.com