CASAP IX
CONGRESO COLOMBIANO Y CONFERENCIA INTERNACIONAL
DE CALIDAD DE AIRE, CAMBIO CLIMÁTICO Y SALUD PÚBLICA

Carbon Footprint of Oxygenated Gasolines in Colombia

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GRACIAS

- Asociación de Combustibles Eficientes de Latinoamérica (ACELA)

- Daniel Pourreau, LyondellBasell

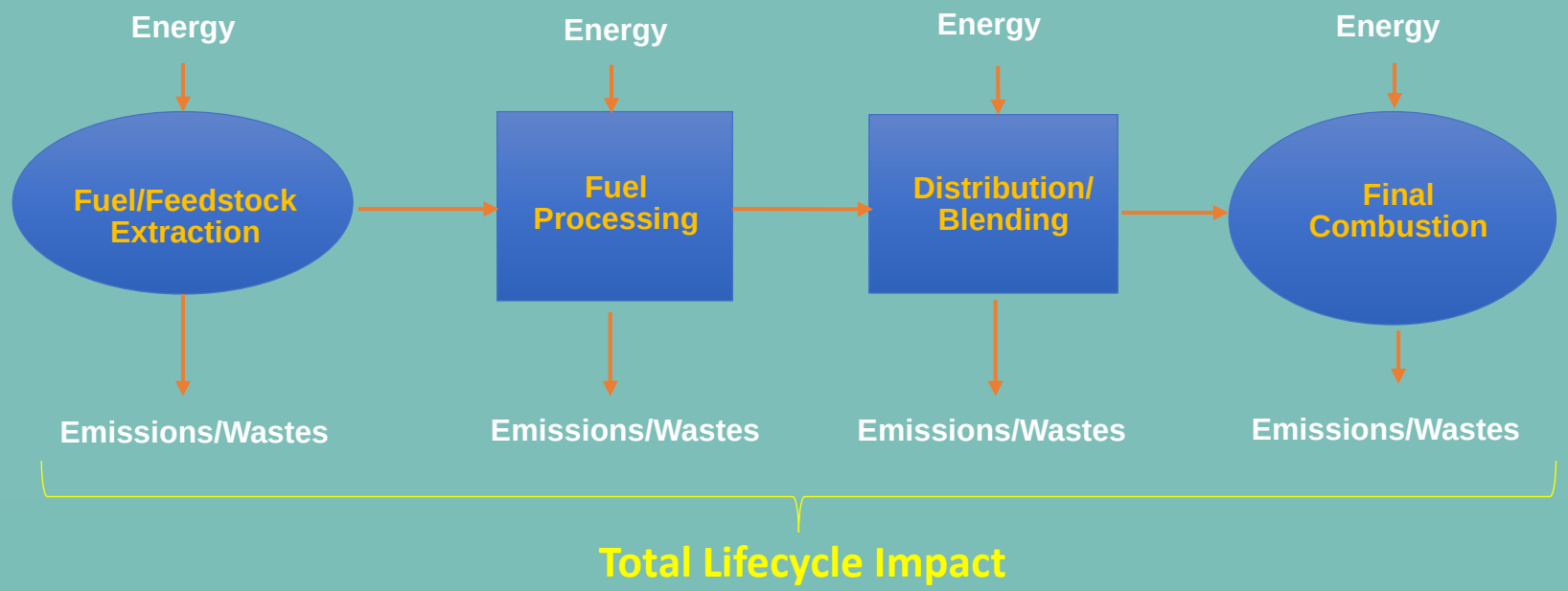
TOPICS

- Why Life Cycle Assessment?
- Study Overview & Objectives
- Analysis Pathways & Data Sources
- Colombia Case Study & Results
- Conclusions & Implications

WHY LIFE CYCLE ASSESSMENT (LCA)?

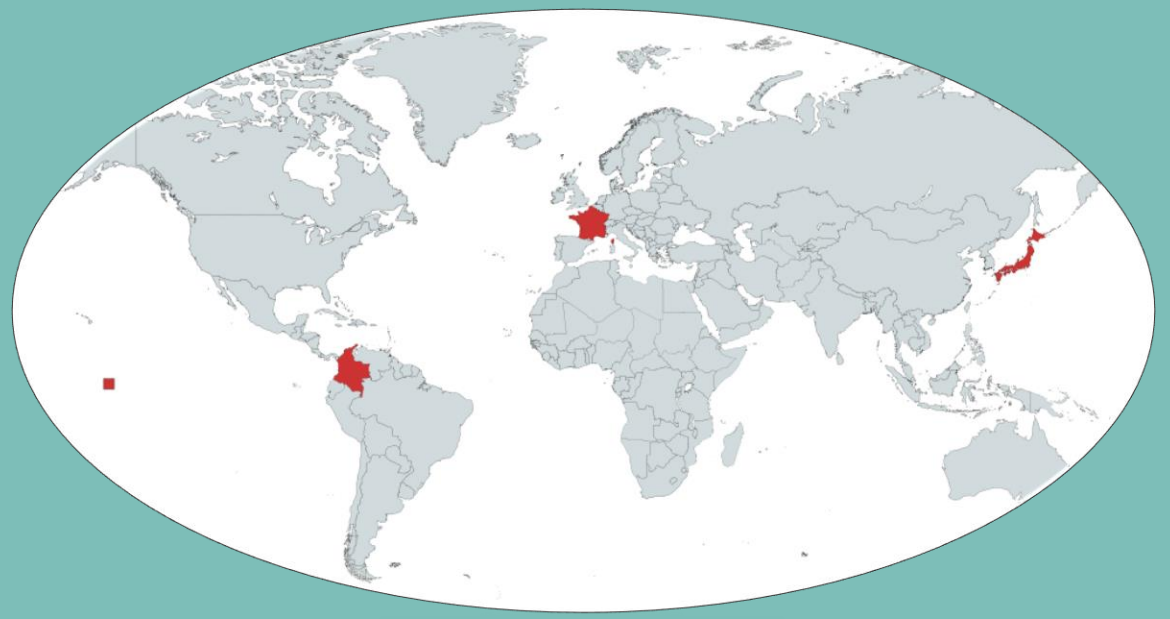
- Assessment of environmental impact must be quantitative and comprehensive for sound policy-making
- “Best Practice” for comparing total emissions across different fuels
- Identifies main contributors to environmental impacts for focusing improvement efforts

“Well-to-Wheels” LCA for Fuels



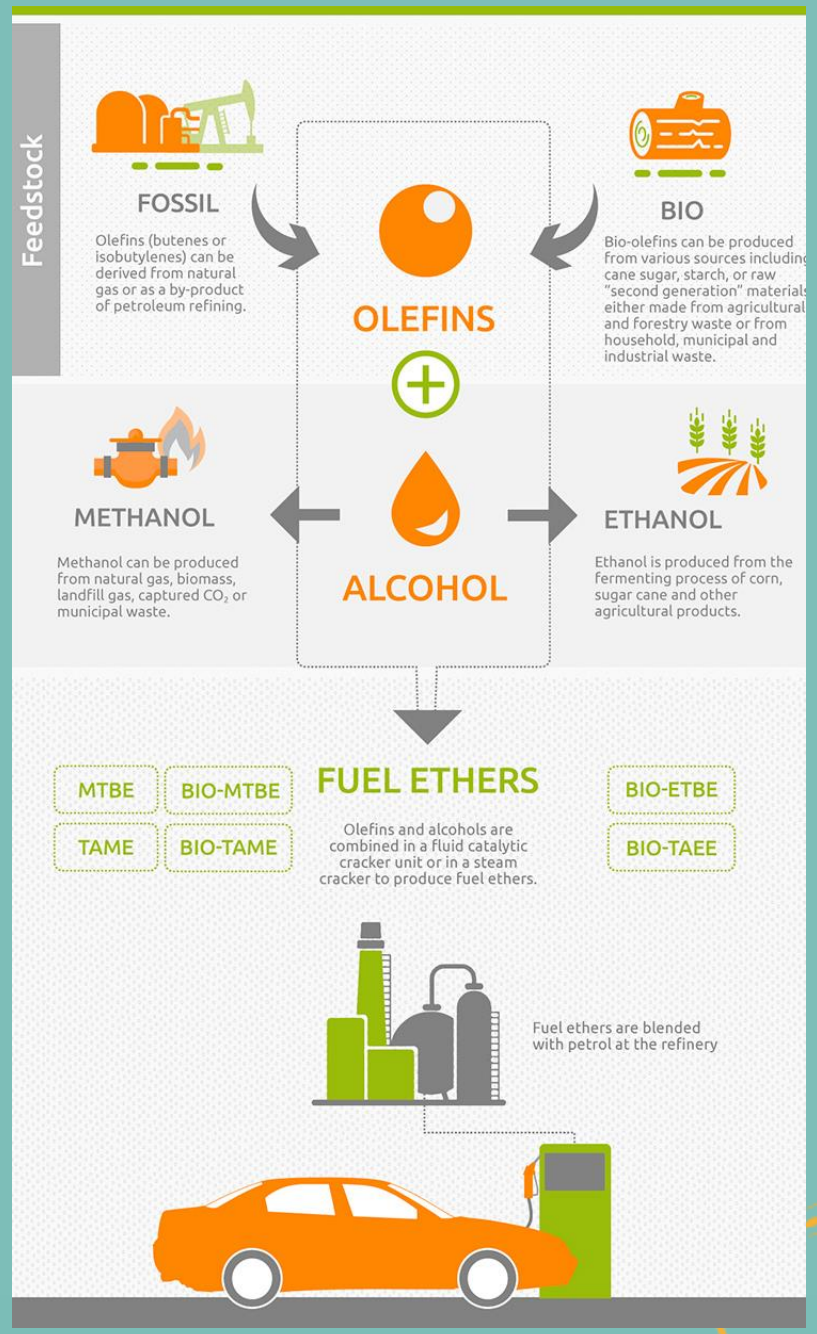
STUDY OVERVIEW

- Well-to-Wheels LCA for oxygenated gasoline in Colombia, Japan, and France
- Considers GHG emissions only (Carbon Footprint), though other emissions and metrics can be considered in future
- Fuel compositions developed to meet octane and oxygen specifications within each country
- Study conducted in accordance with ISO 14067
- Journal article forthcoming



WHAT IS ETBE?

- Fuel ether used as renewable high-octane gasoline blendstock
- Produced from bio-ethanol and isobutylene from various sources
- Benefits compared to ethanol blending:
  - Lowers gasoline evaporative emissions
  - More compatible with other gasoline components, infrastructure, and vehicles
  - Not corrosive or hygroscopic
- Benefits compared to reformate:
  - Cleaner burning – lower exhaust emissions
  - Lower carbon footprint

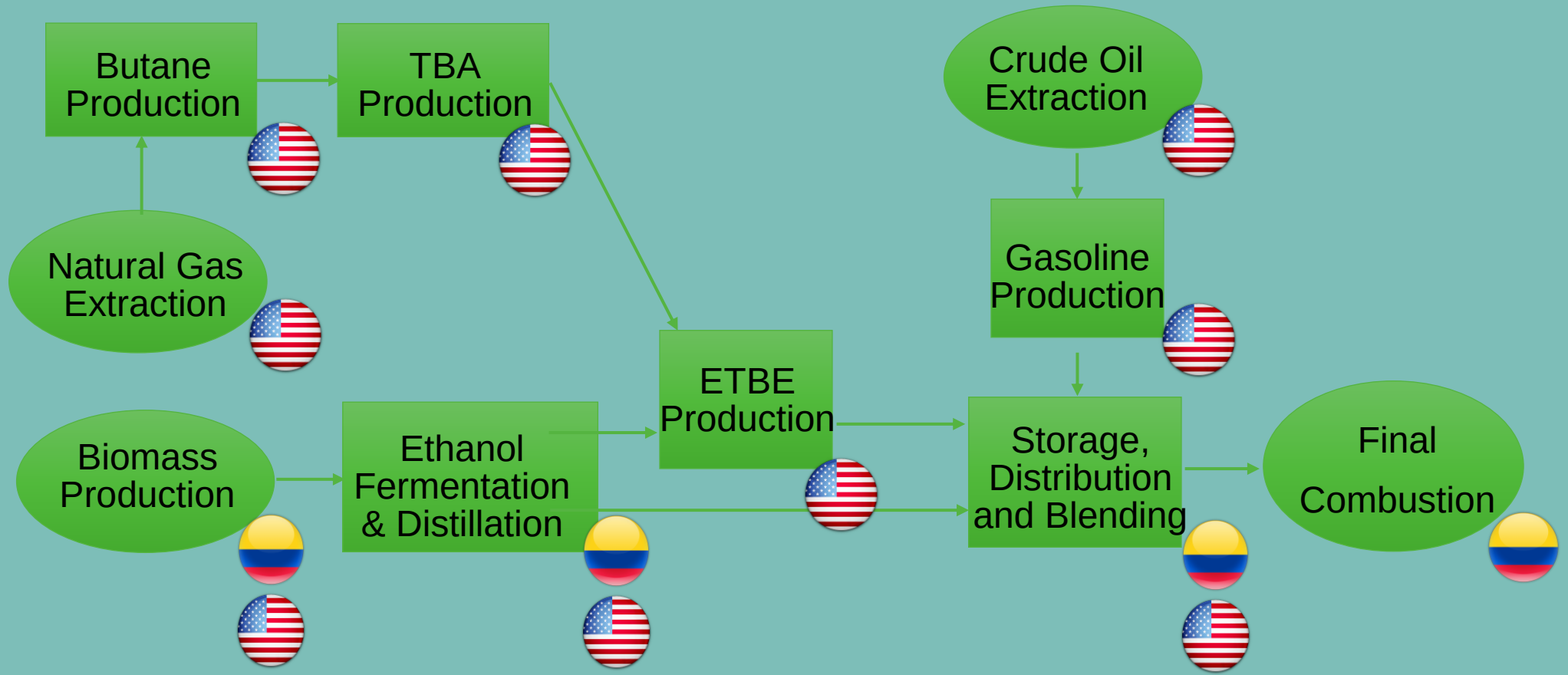


Source: ACELA

COLOMBIA STUDY OBJECTIVES

IMPROVING LCA EMISSIONS

FUEL PATHWAYS



DATA SOURCES

Ethanol

Lifecycle Stage	Emissions Factor Source
Biomass feedstock production	GREET
Land use change	GREET
Ethanol production	GREET
Distribution	GREET

ETBE

Lifecycle Stage	Emissions Factor Source	
Biomass feedstock production	GREET	
Land use change	GREET	
Natural gas extraction	GREET	
Butane production	GREET	
TBA production	Producer data	New Data
ETBE production	Producer data	New Data
Distribution	GREET	

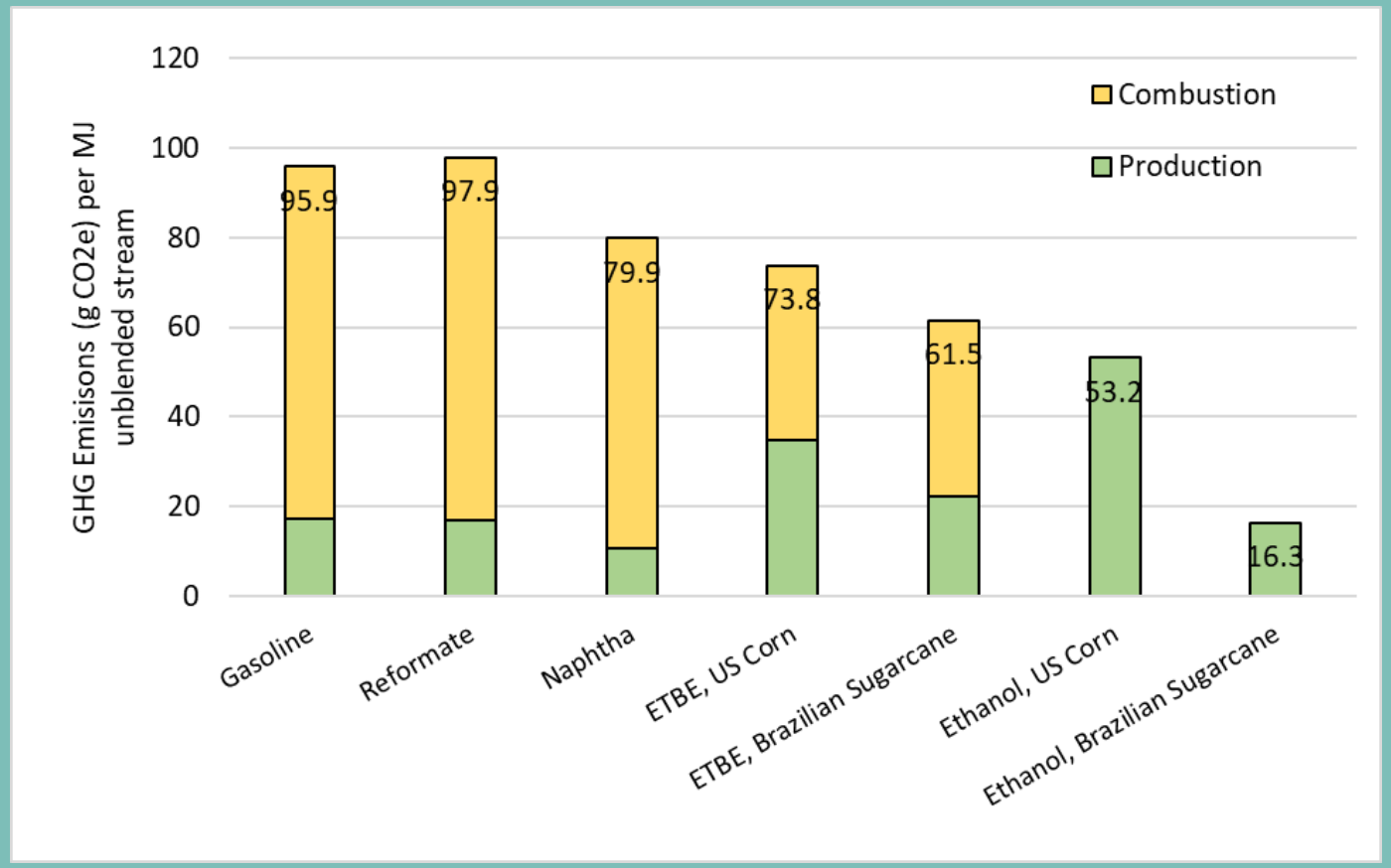
Gasoline Blendstock (BOB)

Gasolina Basica

Lifecycle Stage	Emissions Factor Source	
Crude oil extraction	GREET	
Gasoline production	Petroleum Refinery Life Cycle Inventory Model (PRELIM)	New Data
Distribution	GREET	

UNBLENDED STREAM EMISSIONS

- Reformate is the most carbon-intensive blendstock
- Replacing reformate with ethanol or ETBE lowers the gasoline carbon footprint
- Higher oxygen content of ethanol limits how much reformate can be replaced



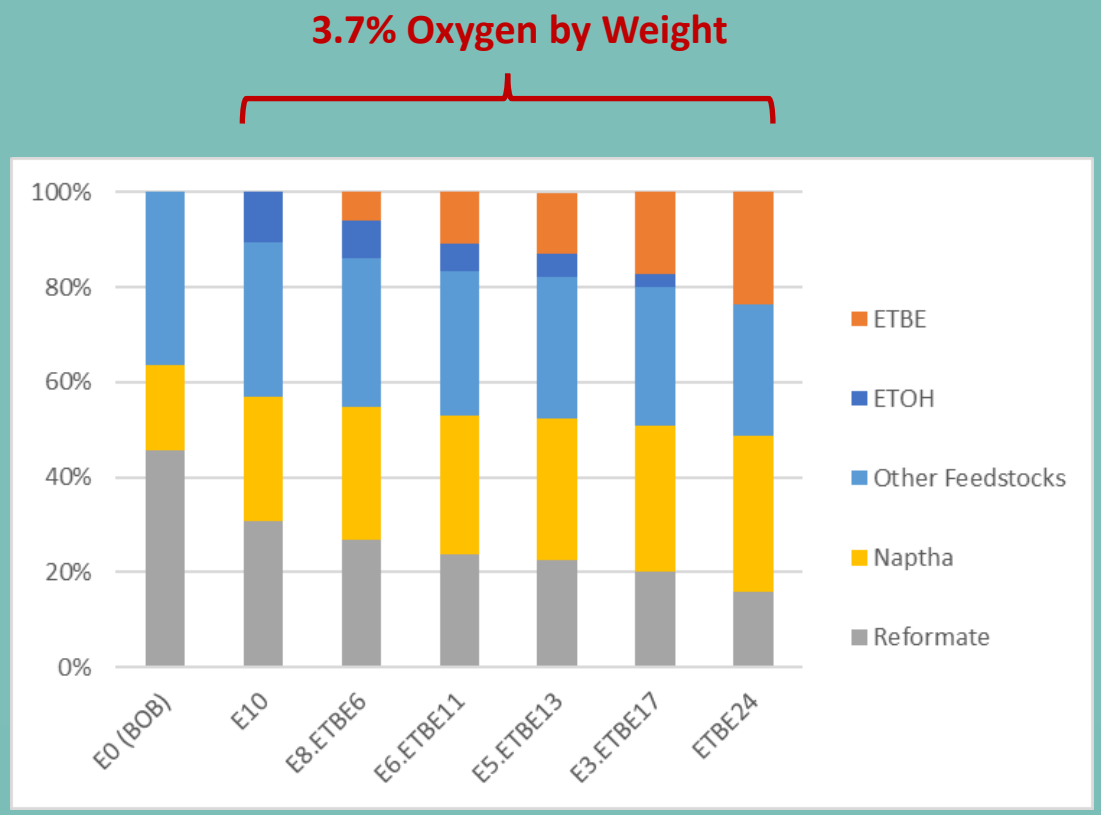
COLOMBIA CASE STUDY

Study Parameters

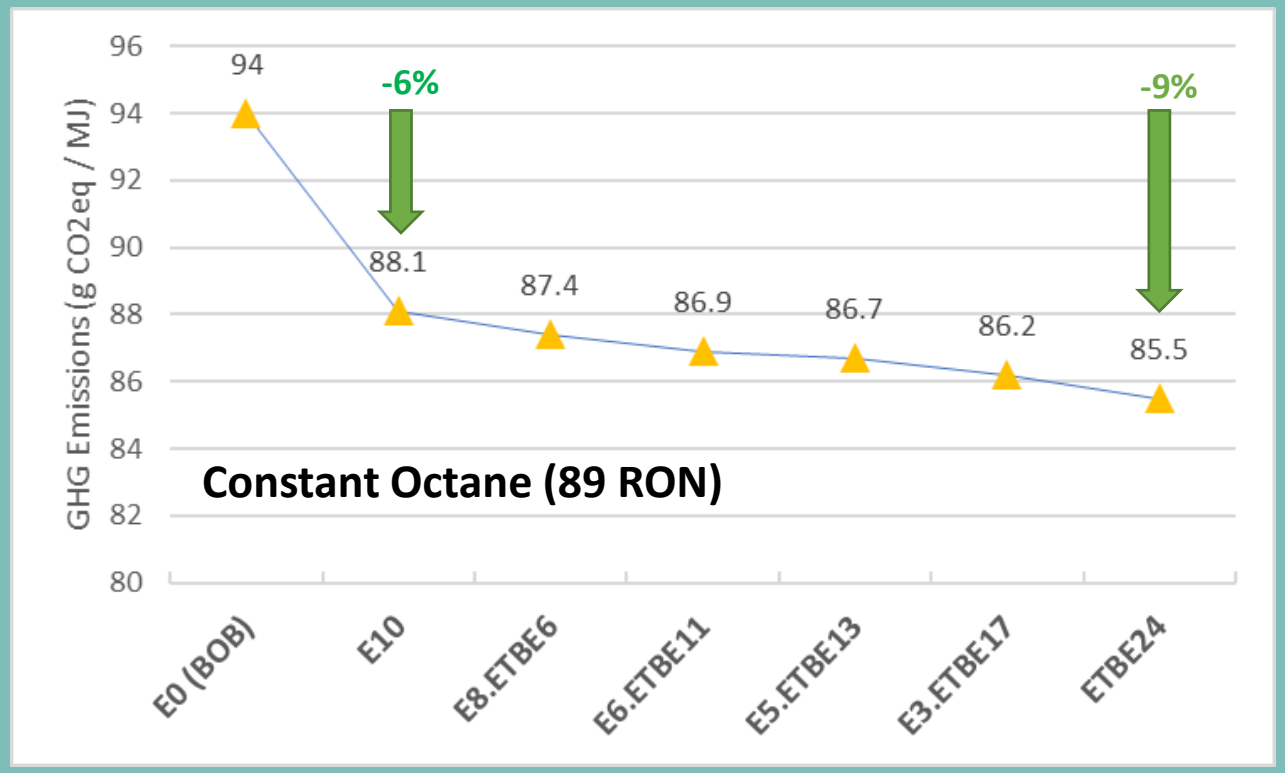
Parameter	Input
Gasoline Production Location	U.S. Gulf Coast
Ethanol Feedstock & Production	55% Colombian Sugarcane / Ethanol produced in Colombia
	45%: U.S. Corn / Ethanol produced in U.S. MIdwest
Ethanol Source for ETBE	Same as above
ETBE Production Location	U.S. Gulf Coast
ETBE Production Method	TBA Pathway
Land Use Change	Yes
Corn Displacement	Yes

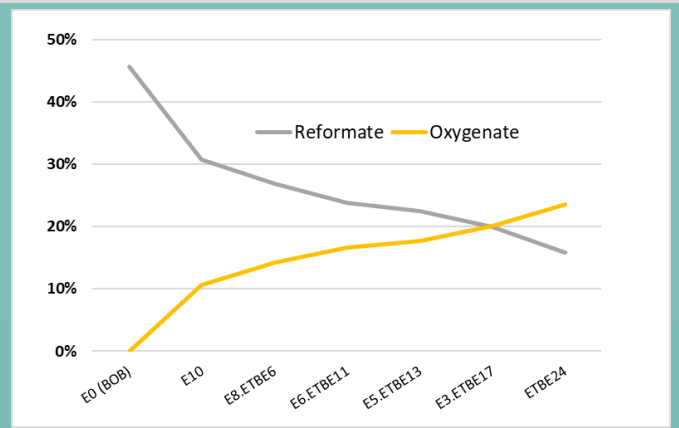
Fuels Compositions

ETBE replaces twice as much reformate as ethanol at the same oxygen content



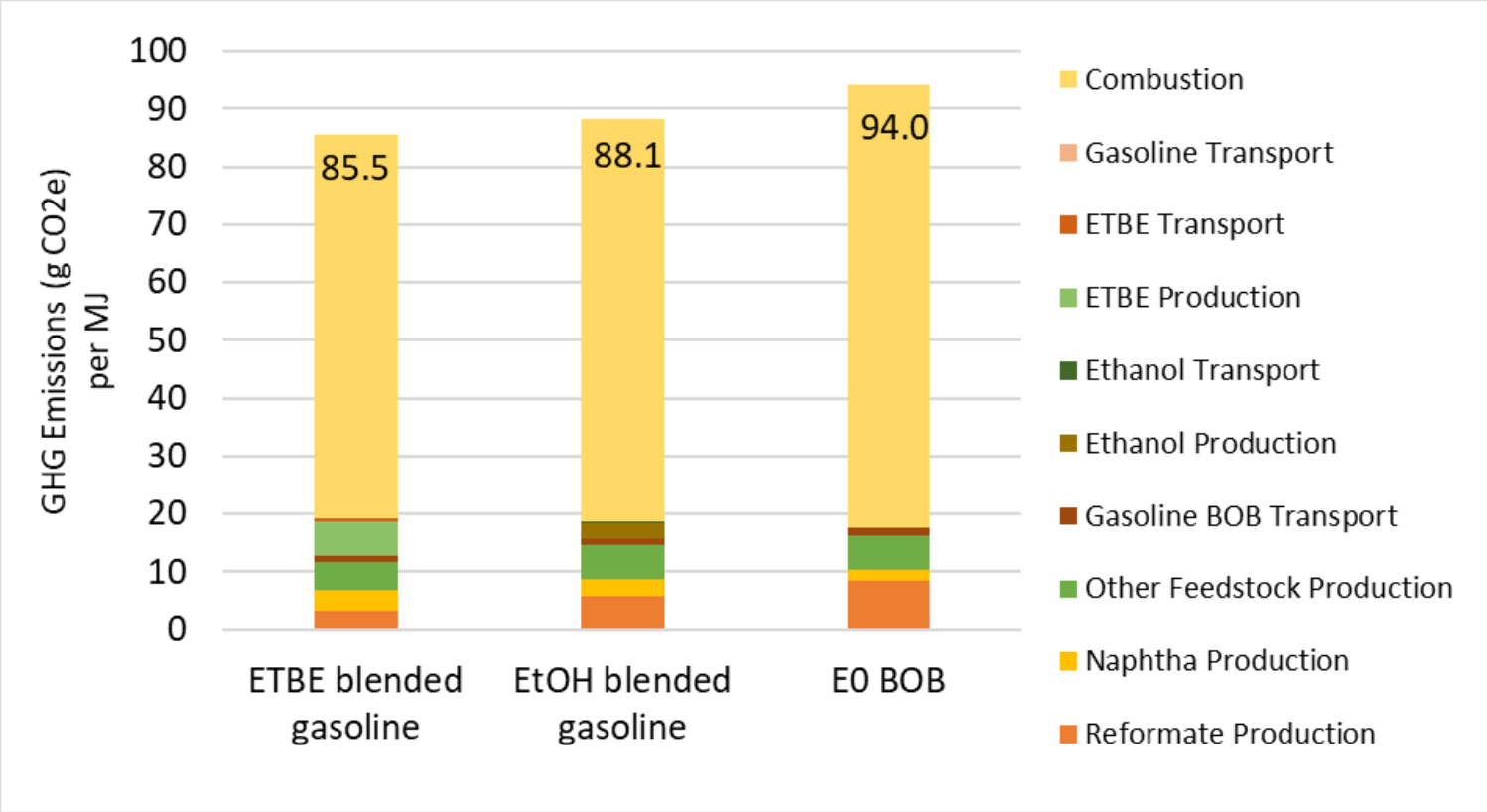
LIFECYCLE GHG EMISSIONS





- Oxygenated fuel GHGs < Gasolina Basica (E0)
- GHGs decrease with increasing volume of ETBE displacing reformate at same oxygen level
- GHG reductions 30% more with ETBE24 vs. E10

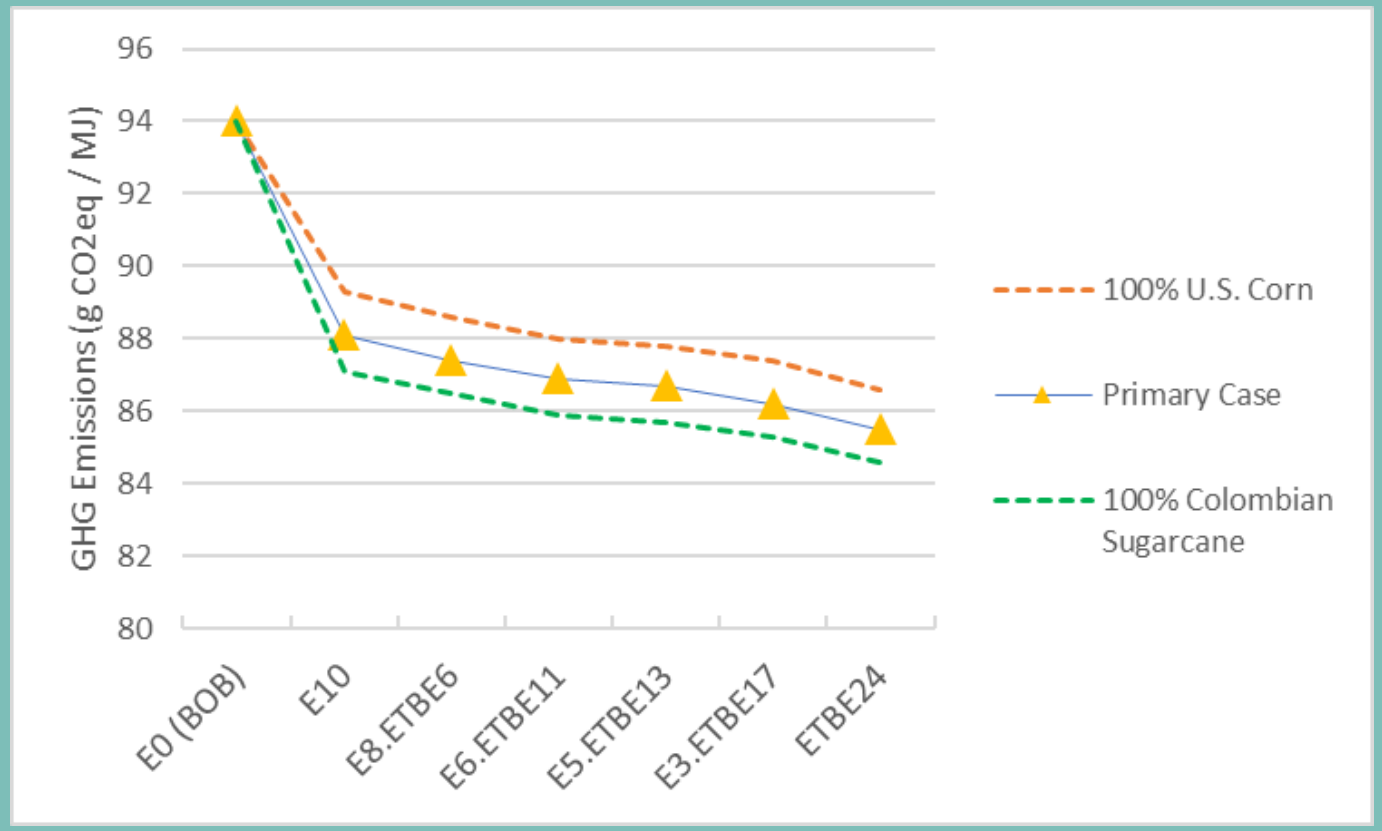
EMISSIONS BY STAGE



- End-use combustion generates majority of gasoline emissions
- EtOH in ETBE doesn't contribute to combustion CO_2
- Higher volume of ETBE at 3.7 wt. % oxygen lowers emissions more than ethanol

SENSITIVITY TO ETHANOL SOURCE

What if Ethanol was sourced 100% from U.S. 100% or 100% from Colombia?



- Varies GHGs ± 2%
- Lower yield from corn starch raises emissions for U.S. scenario
- ETBE24 GHG reduction 10% vs. E0 for Colombia scenario

CONCLUSIONS & IMPLICATIONS

- New LCA data advances state-of-the-science for analyzing oxygenated fuel GHGs
- Use of oxygenated fuel shows to reduces carbon footprint 6-9% at 89 RON
- Largest GHG reduction provided with maximum ETBE blend
- Results hold regardless of ethanol source
- Using ETBE allows > 89 RON to be achieved without GHG penalty

Policy implications:

- Blending renewable-based oxygenated fuels reduces carbon emissions
- Using ETBE as the oxygenate provides additional GHG benefit
- ETBE allows production of higher-octane & cleaner-burning fuels