

Comparative Life Cycle GHG Emissions of FT-Liquid Fuels from Coal and Natural Gas

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INTRODUCTION

- Demand for petroleum-derived transportation fuels expected to increase:
 - Energy Security
 - Growing GHG Emissions
- FT-Liquids from Coal and NG could be an alternative

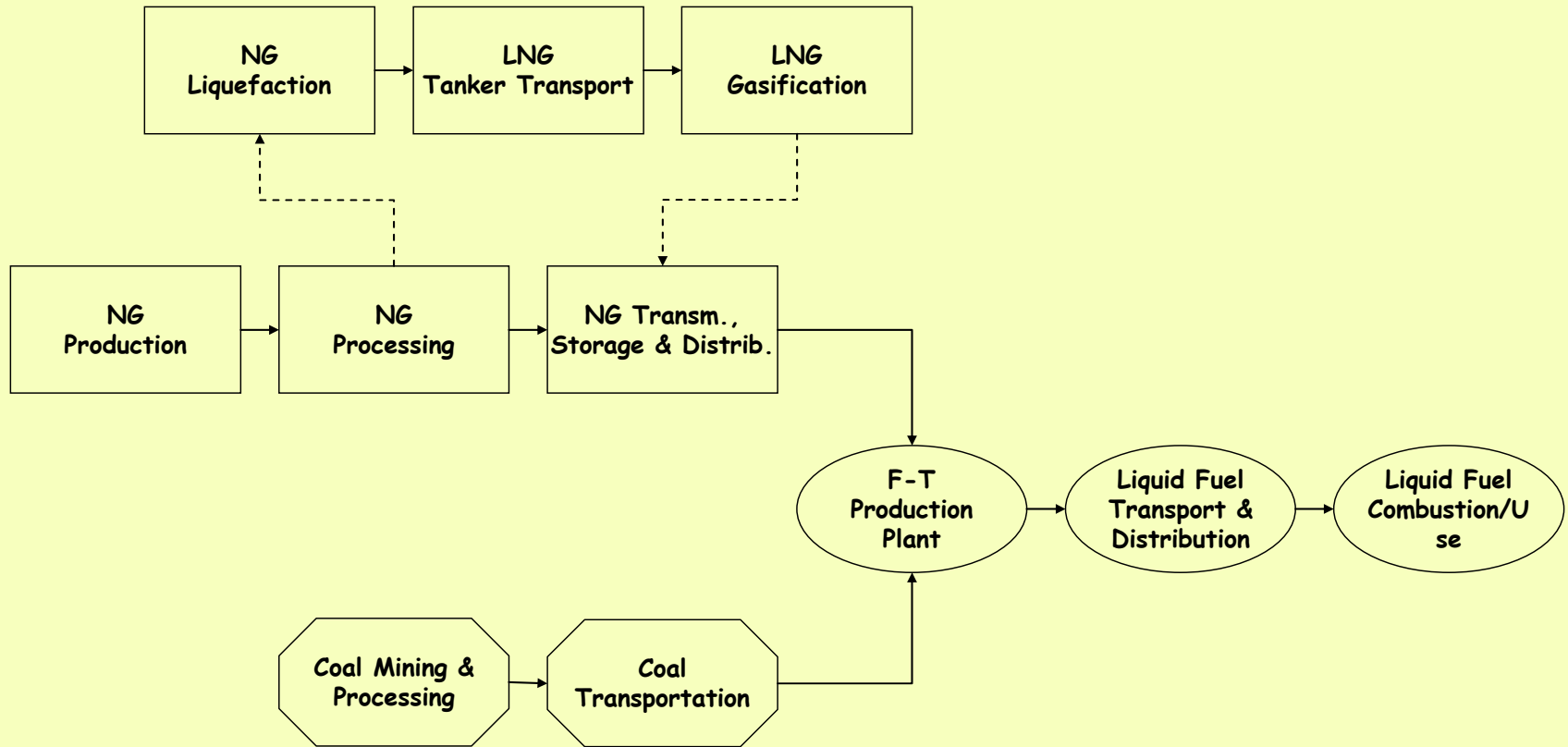
FT-LIQUIDS BASIC

- FT-Liquids from coal (CTL):
 - Syngas through Coal Gasification
 - Syngas to liquid fuels.
- FT- Liquids from natural gas (GTL):
 - Syngas through Steam Methane Reforming
 - Syngas to liquid fuels.

FT-LIQUID PATHWAYS

Pathway	Description
Benchmark CTL Plant	In this pathway slightly more diesel (53 %) than gasoline (44%) is produced. The rest is propane.
Maximum Gasoline Production CTL Plant	The CTL plant in this pathway is upgraded with catalysts that change the product ratio from the benchmark CTL plant to 20% diesel, 73% gasoline and, 7% propylene and propane.
GTL Plant: Domestic Natural Gas	The conventional GTL plant, produces 62% diesel, 35% gasoline, and 3% propane. This plant is built in the U.S. and fed with domestic natural gas.
GTL Plant: LNG	The conventional GTL plant as above but it imported LNG as a feedstock.
Imported GTL fuels	The conventional GTL plant is built in Qatar or Malaysia and the refined fuels are imported by the U.S.

FT-LIQUID FUELS LIFE CYCLE



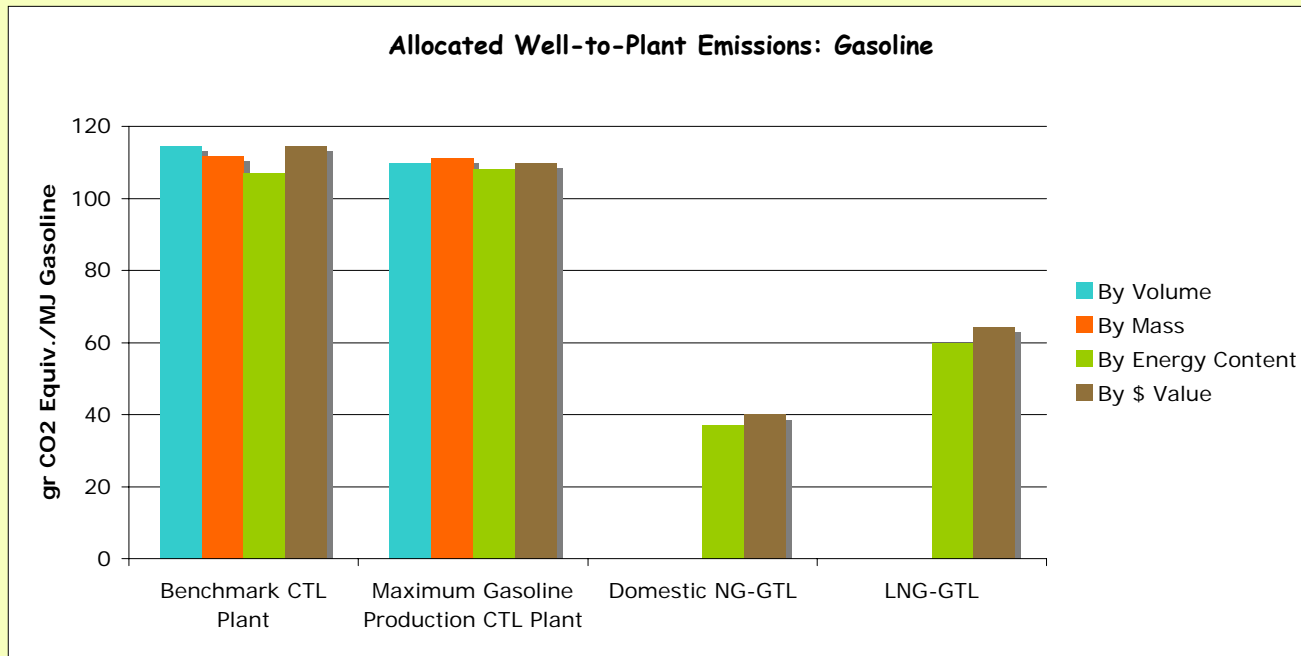
LCA BOUNDARY

- Production, Processing, and Transport of Feedstock Fuels
- FT-Plant Emissions
- Electricity Used at FT-Plant
- Transport of FT-Fuels
- Combustion at Use

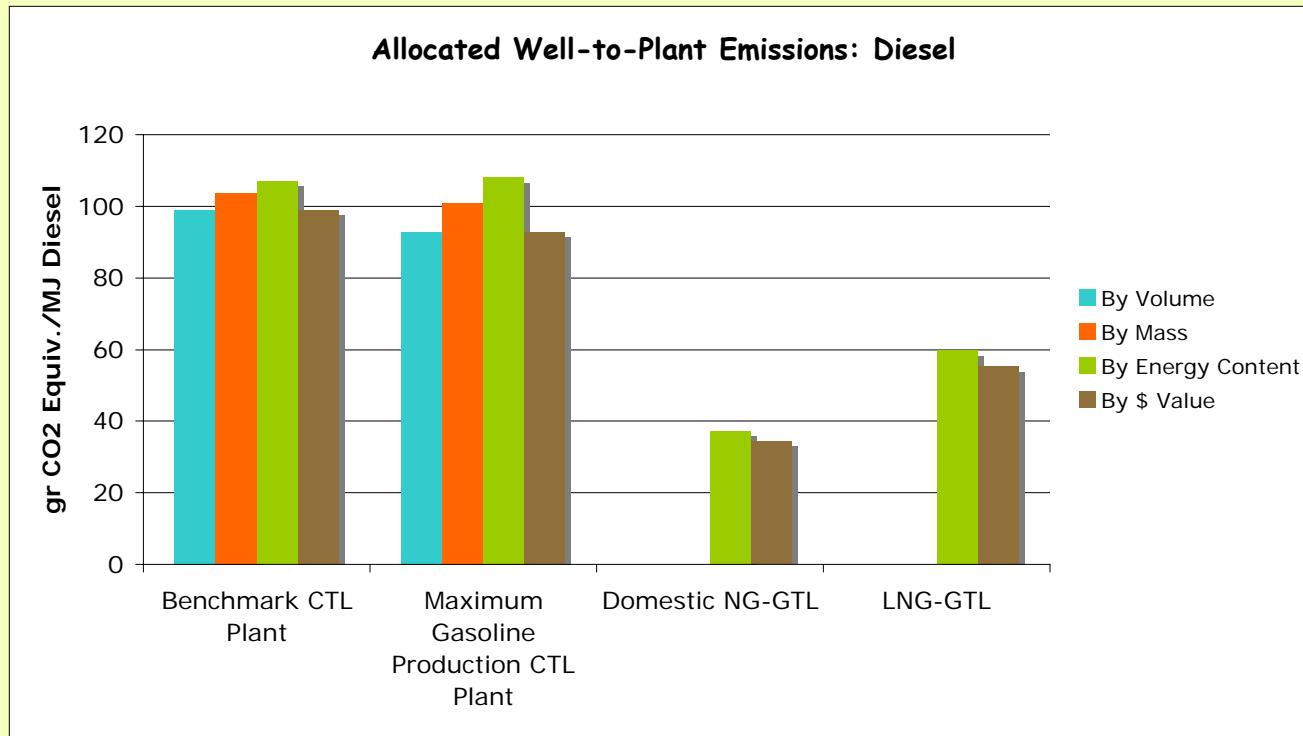
ALLOCATION OF WELL-TO-PLANT EMISSIONS

- GREET Model Allocation
 - By Mass
 - By Volume
 - By Energy Content
 - By \$
- Wang et.al Detailed Plant Process Allocation

GREET MODEL ALLOCATION- GASOLINE

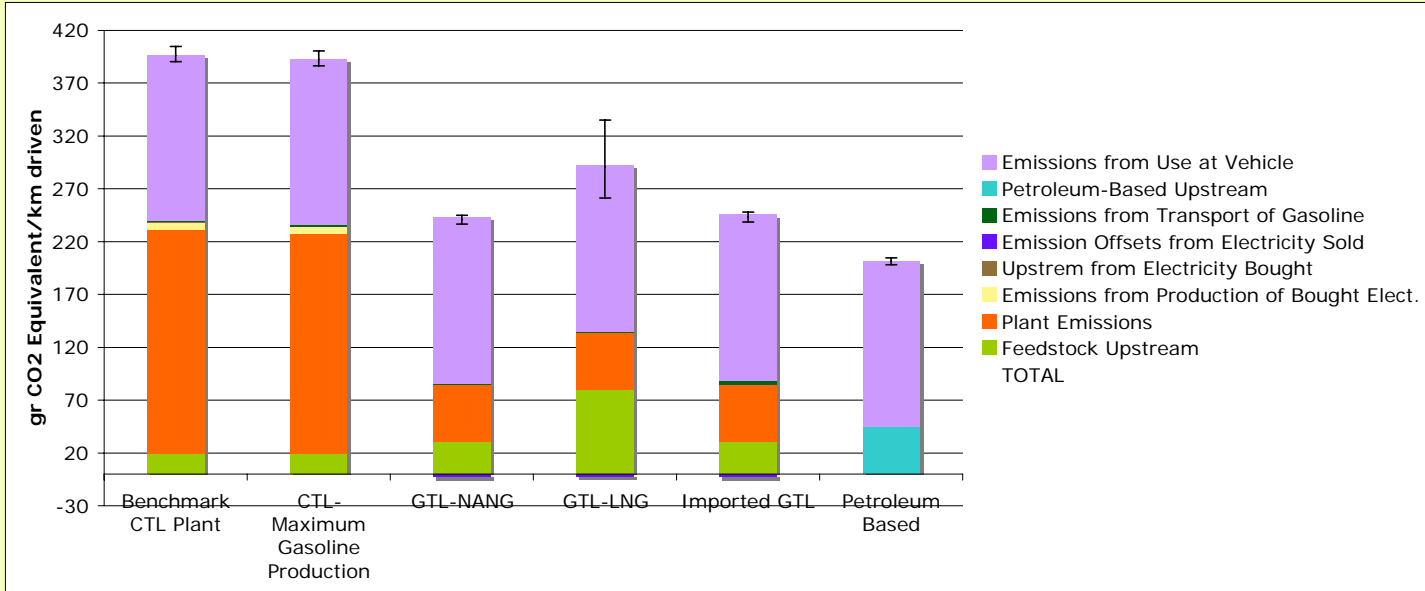


REET MODEL ALLOCATION-DIESEL



- Add emissions from liquid fuel transport and fuel combustion to allocated well-to-plant emissions to obtain well-to-wheel emissions.
- Vehicle Characteristics: Toyota Corolla
 - Gasoline: 34 mpg
 - Diesel: 47 mpg

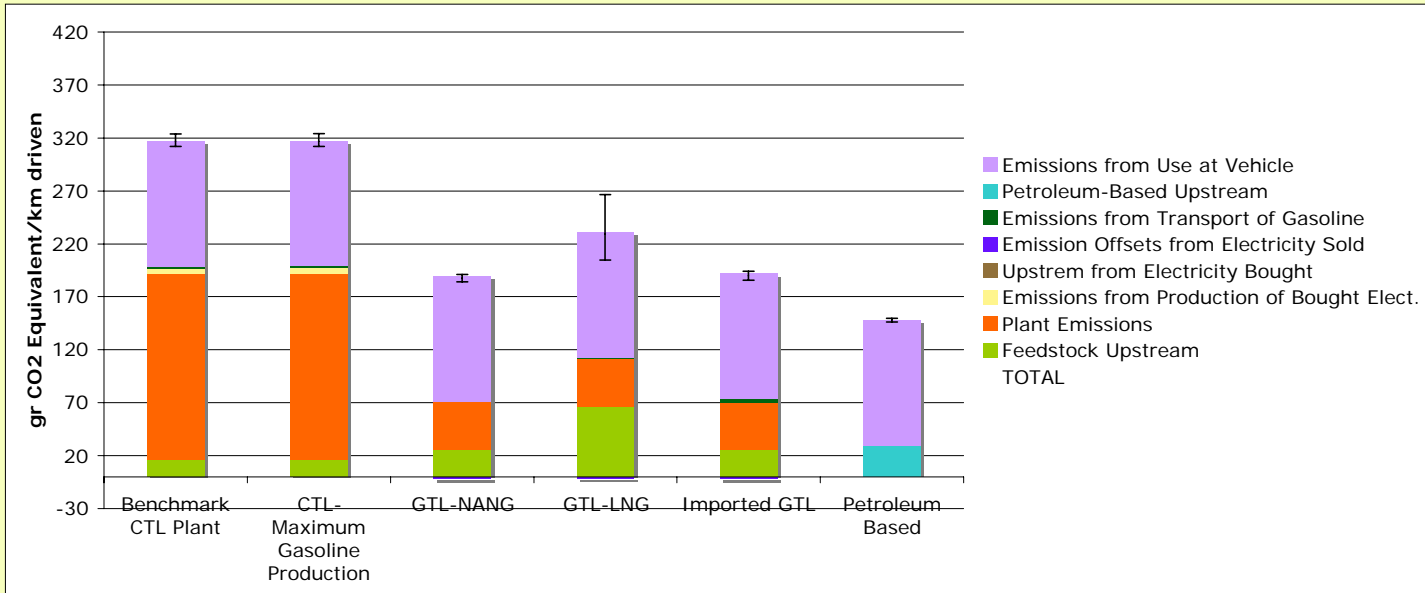
WELL-TO-WHEEL EMISSIONS OF FT-GASOLINE



CTL gasoline has double the emissions of petroleum based gasoline.

GTL gasoline between 20% and 45% higher than petroleum based gasoline.

WELL-TO-WHEEL EMISSIONS OF FT-DIESEL



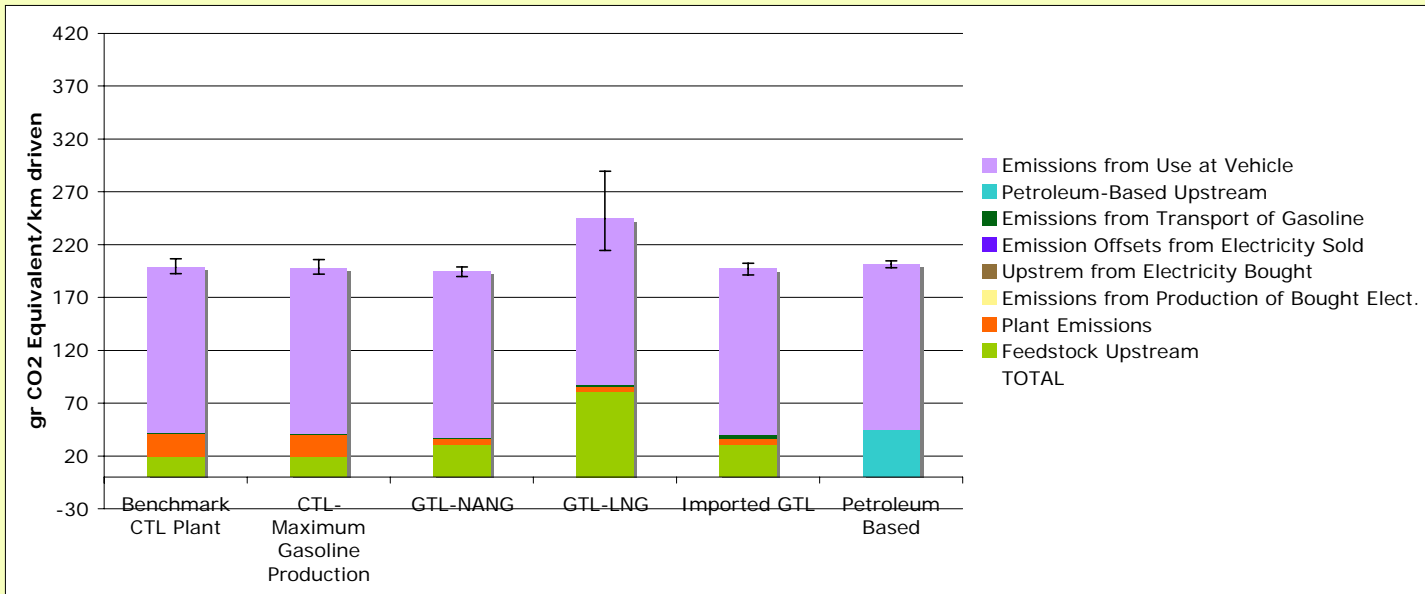
CTL gasoline 85% higher than petroleum based diesel.

GTL gasoline between 20% and 45% higher than petroleum based diesel.

ALTERNATIVE SCENARIO

- With 90% CCS at plant
 - » Carbon separation is already done at these plant.
 - » Additional electrical requirements for carbon compression: 80 to 140 MWh/tonne CO₂ compressed
- Electricity Generated with low-carbon sources

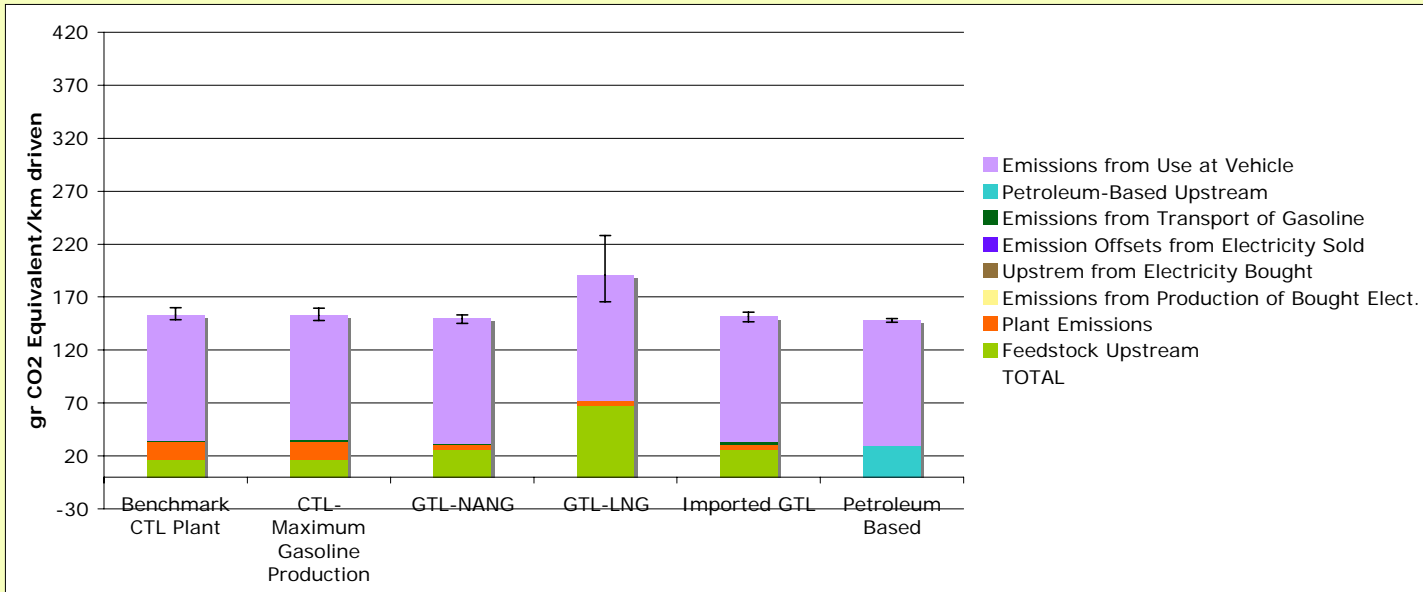
WELL-TO-WHEEL EMISSIONS OF FT-GASOLINE



CTL, GTL-NANG, and imported GTL gasoline have slightly lower emissions compared to petroleum based gasoline.

GTL-LNG will not reduce GHG emissions from gasoline consumption.

WELL-TO-WHEEL EMISSIONS OF DIESEL



CTL, GTL-NANG, and imported GTL diesel have slightly lower emissions compared to petroleum based gasoline.

GTL-LNG will not reduce GHG emissions from diesel consumption.

CONCLUSIONS

- If no *CCS* is available, *CTL* and *GTL* liquids could significantly increase *GHG* emissions associated with transportation fuels.
- If *CCS* is available, slight reduction could be observed

**QUESTIONS, COMMENTS,
SUGGESTIONS?**