Quantitative Policy Analysis for Sustainable Alternative Fuel Technologies

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Background

- Many sustainable alterative fuel (SAF) technologies are approaching commercial production.
- Some examples are:
  - Neste partners with Air BP to deliver SAFs to Sweden
  - Fulcrum Sierra BioFuels Plant
  - Velocys UK waste to fuel project

Image source: Neste Press Release

Background

- Many sustainable alterative fuel (SAF) technologies are approaching commercial production.
- Some examples are:
  - Neste partners with Air BP to deliver SAFs to Sweden
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  - Velocys UK waste to fuel project

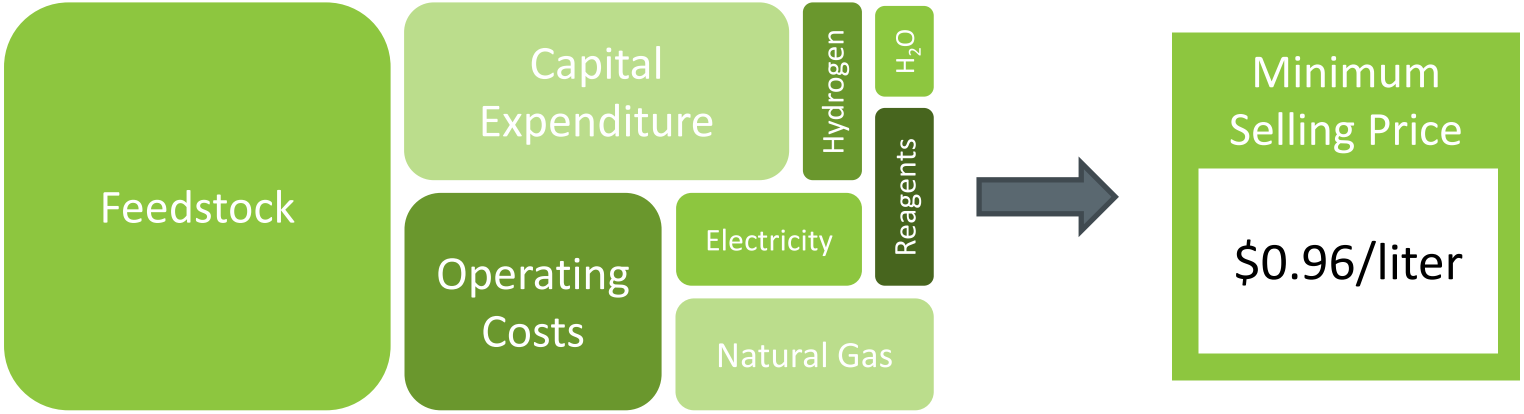
We want to know how the production costs of these SAFs compare to petroleum-derived fuels

Quantitative Policy Assessment

Model the economics of fuel production for a pathway of interest → Simulate potential policies' impact on economic viability → Use results to identify promising policy options for both policy makers and producers

Determining Minimum Selling Price

EX: Alcohol to Jet via iBuOH from corn grain



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Determining Minimum Selling Price

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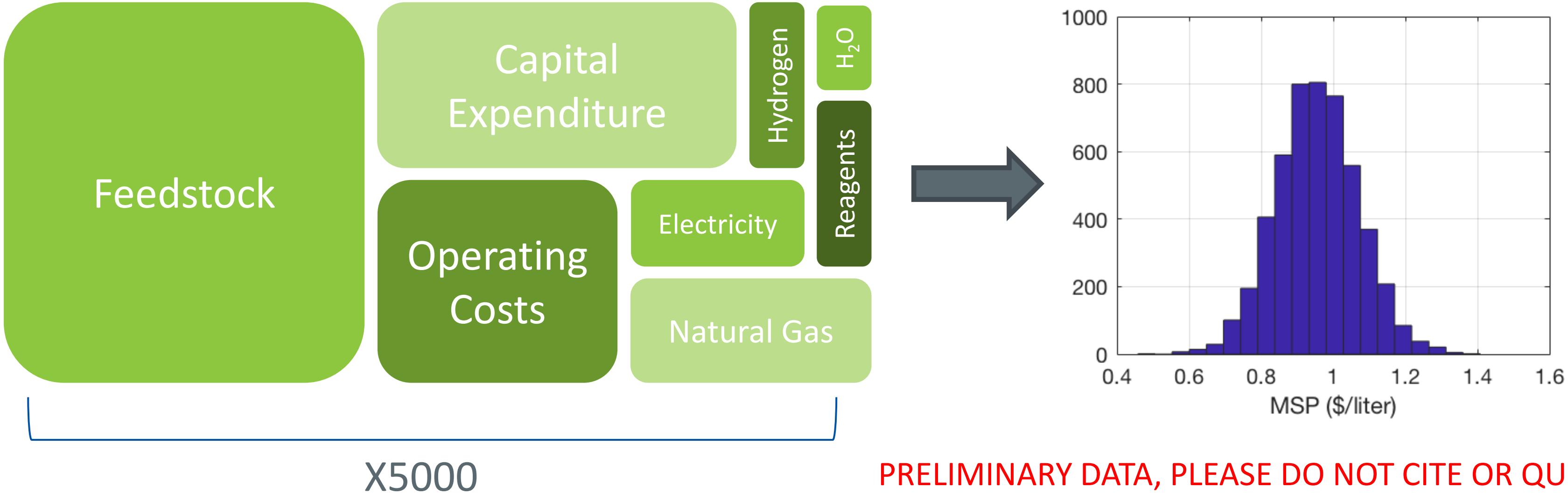

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Compare to Petroleum Jet Fuel Prices

Our Minimum Selling Price		Petroleum Jet Fuel Price
$0.96/liter	>	$0.53/liter[1]

However… there are policies in place to support alternative fuels

1. IATA Jet Fuel Price Monitor accessed 4/18/19

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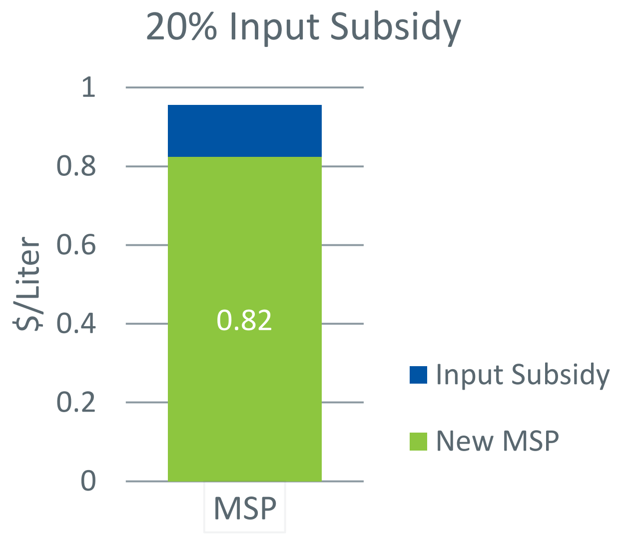
Policy Options (1/5)

- **Input Subsidy**
  - Reduction in feedstock costs
  - Ex. Brazil's "Social Fuel Standard"
  - This is modelled as a percentage change in feedstock costs.



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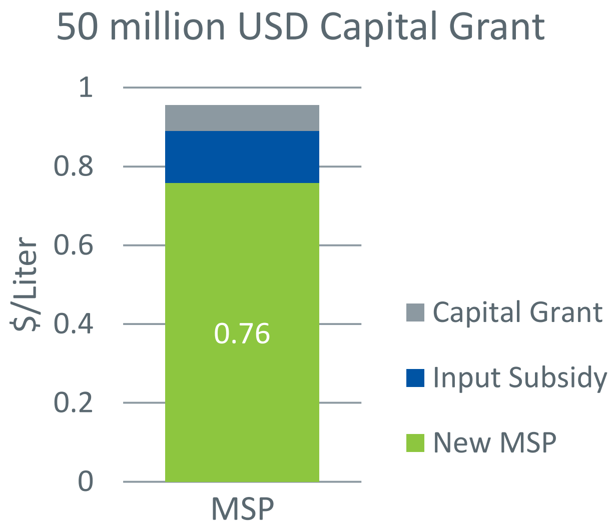
Policy Options (2/5)

- **Capital Grant**
  - Producer receives a subsidy for facility construction.
  - Ex. US Department of Defence, Defence Production Act grant
  - This is modelled as a decrease in capital expenditure costs



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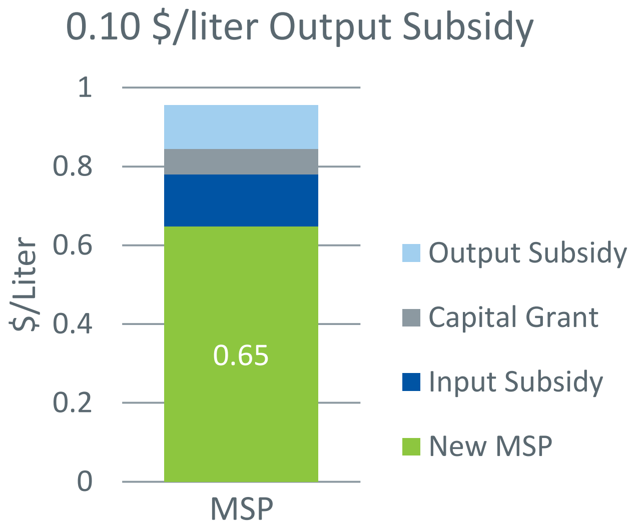
Policy Options (3/5)

- **Output Subsidy**
  - Producer receives a subsidy per quantity of production
  - May be based on GHG emissions reductions, meaning the $/litre depends on the life cycle CO_2 emissions of the fuel
  - Ex. CORSIA



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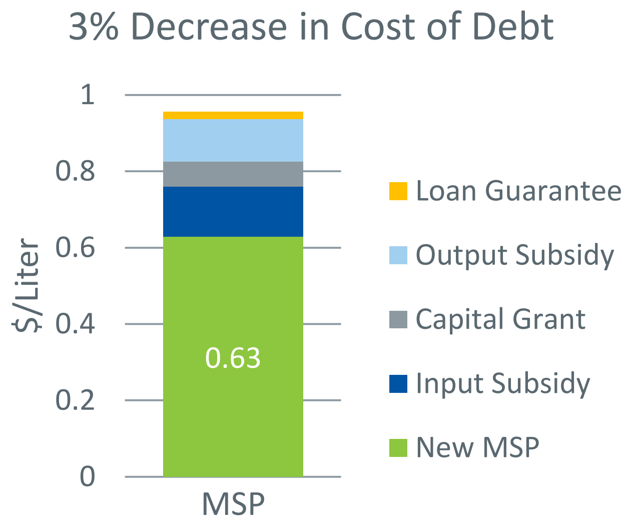
Policy Options (4/5)

- **Loan Guarantee**
  - Ensures that if a refinery defaults on the loan, it will be paid back
  - This is modelled as a reduction in the cost of debt
  - Other ways of modelling could include modifying the capital structure and cost of equity
  - Ex. US Department of Energy Title 17 Innovative Energy Loan Guarantee Program



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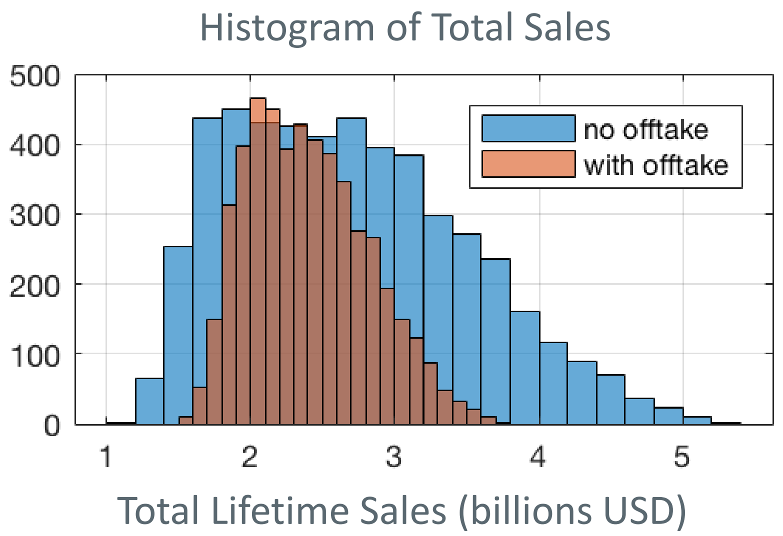
Policy Options (5/5)

- **Offtake Agreement**
  - A buyer guarantees that it will buy the product at a specified price
  - This policy is modelled considering both the specified price and also the amount bought
  - In the case that has been modelled, a buyer agrees to buy 50% of the fuel produced at the cost of 0.63 $/litre. (This does not change MSP)
  - Ex. Shell and Next Renewable Fuels



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Interaction Between Policy Options

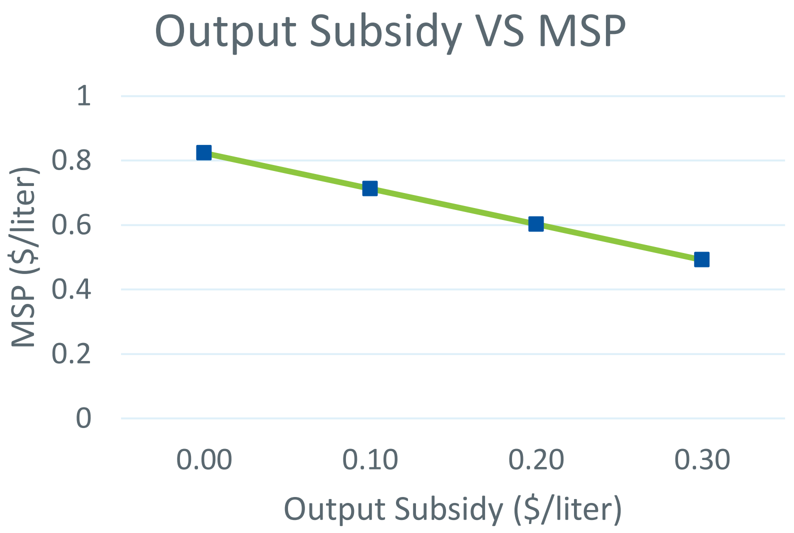
- Certain policies do not affect each other when combined.
  - Ex. Output Subsidy and Input Subsidy

- Some policies can influence other policies when they are combined
  - Ex. Combining capital grant and loan guarantee. The capital grant can change amount of debt which affects the result of a loan guarantee

Evaluation of Policy Options

- Certain policies only impact the **median** MSP.
  - Output subsidy
  - Capital grant

- There is a linear relationship between the magnitude of the policy and the impact on median MSP



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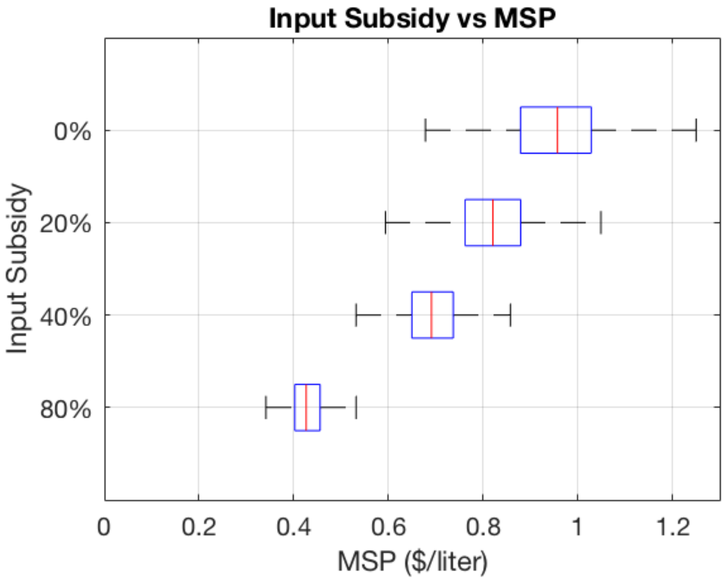
Evaluation of Policy Options

- Other polices can also impact the **variance** in MSP.
  - Input subsidy
  - Loan guarantee
  - Offtake agreement

- A decrease in variance means the project is less risky. This is an important consideration for project economics.



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Conclusions on Evaluation of Policy Options

- Different policies impact project economics in different ways. This is an important consideration for policy-makers, depending on their objectives.
- Some policies are effective at reducing median MSP.
  - Ex. Output subsidy, Capital grant
- Others are effective at reducing project risk.
  - Ex. Input subsidy, Loan guarantee, Offtake agreement

Real-world Policy Cases

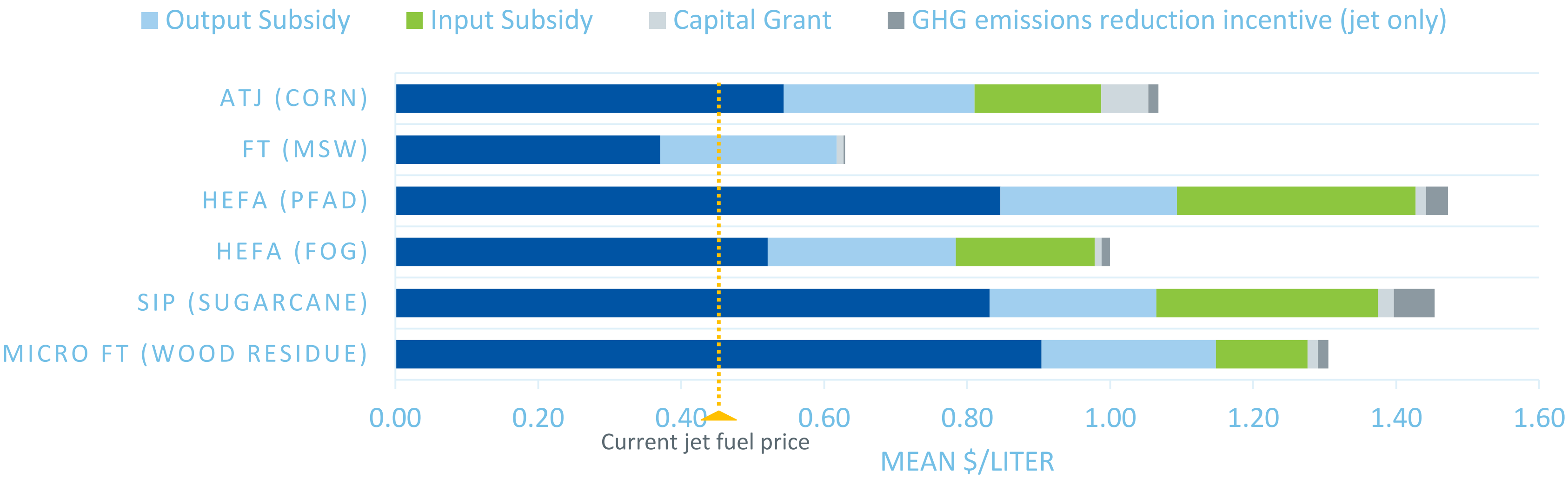
Output Subsidy (RFS RIN values)	Input Subsidy (Data from Indonesia)	Capital Grant (CalRecycle Organics Recycling Project)	GHG Emissions Reduction Incentive - Jet only (CORSIA)
0.25 $/Liter	27% feedstock cost subsidy	5 mil. USD capital grant	20 USD/t_{CO2} reduction credit (40 USD/t_{CO2} by 2035)

Technology Cases

Process	Feedstock
Micro - Fischer-Tropsch	Forest residues
HFS-SIP	Sugarcane
HEFA	Waste fats, oils and greases (FOG)
HEFA	Palm oil/palm fatty acid distillates (PFAD)
Fischer-Tropsch	Municipal solid waste
ATJ (via. iBuOH)	Corn

Technology Case Results

POLICY EFFECTS ON MSP



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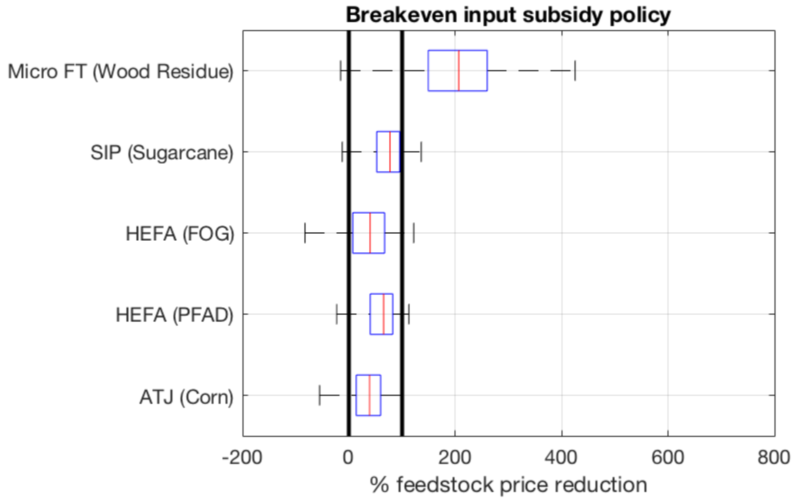
Conclusions from Technology Cases

- The production cost of SAFs are generally more costly than petroleum derived fuels today.
- However, by considering the combined impact of multiple policies (based on real world policy examples), some pathways such as corn grain ATJ, MSW FT, and FOG HEFA may approach become cost competitiveness with petroleum jet fuels.

Useful Tool for Policy Makers

Example: These tools can be used to determine the magnitude of **breakeven policies** required to make SAF technologies pathways cost-competitive with traditional ones.



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Limitations in the Analysis

Policy modelling

- Currently only uniform policies are modeled. Policy variation over time is not accounted for.
- Tax laws and other local/specific conditions may influence results significantly. These are not accounted for in this study.
- We do not account for other options to reduce cost (potentially significantly), such as brownfield construction, or retrofitting of existing industrial facilities.

Pathway modelling

- We only capture a subset of available SAF pathways
- Study is for a n^{th} plant analysis. Costs are still uncertain, as these are new technologies
- Future commodity prices are highly uncertain (feedstock, electricity, NG)

Thank you

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THANK YOU

Year	2020	2021	2022	2023	2024	2025	2026	2027
Mid	8.00	8.70	9.40	10.10	10.80	11.50	12.20	12.90
High	20.00	21.30	22.60	23.90	25.20	26.50	29.80	29.10
Alternative Low	6.00	6.40	6.80	7.20	7.60	8.00	8.40	8.80

Year	2028	2029	2030	2031	2032	2033	2034	2035
Mid	13.60	14.30	15.00	16.00	17.00	18.00	19.00	20.00
High	30.40	31.70	33.00	34.40	35.80	37.20	38.60	40.00
Alternative Low	9.20	9.60	10.00	10.40	10.80	11.20	11.60	12.00

Pathway	GHG emissions (gCO2e/MJ)
Baseline	89.0
SIP (Sugarcane)	50.6*
HEFA (FOG)	22.5
HEFA (PFAD)	20.7
FT (MSW)	40
ATJ via. iBuOH (Corn)	75*

All values are Unit Cost of Carbon in $/tCO_2$