ASCENT Project 1
Stochastic techno-economic assessment of policy impact on the economics of alternative jet fuels

MIT LABORATORY FOR AVIATION AND THE ENVIRONMENT

Motivation and Objectives

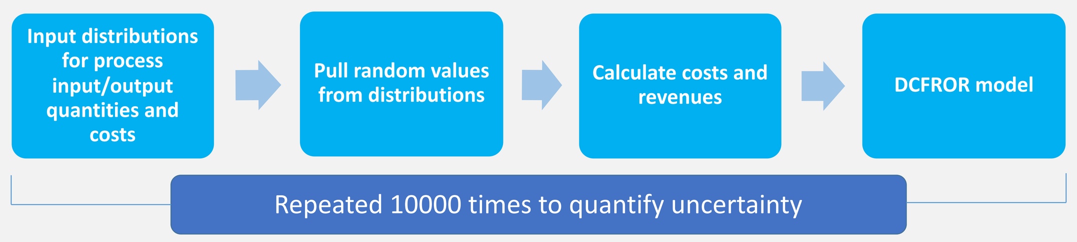
- Aviation contributes to approximately 2% of anthropogenic CO_2 emissions.
- Alternative fuels have the potential to reduce dependence on fossil fuels, and lower the net life cycle greenhouse gas emissions of commercial aviation.
- A number of alternative jet fuel technologies have been shown to be technically feasible, and to offer the potential for life cycle GHG emissions reductions, but may not be economically viable on a commercial scale.
- However, targeted policies could improve the financial viability of alternative jet fuel technologies, which leads to the research question:

How do different policy types impact the economic viability of alternative jet fuel technologies?

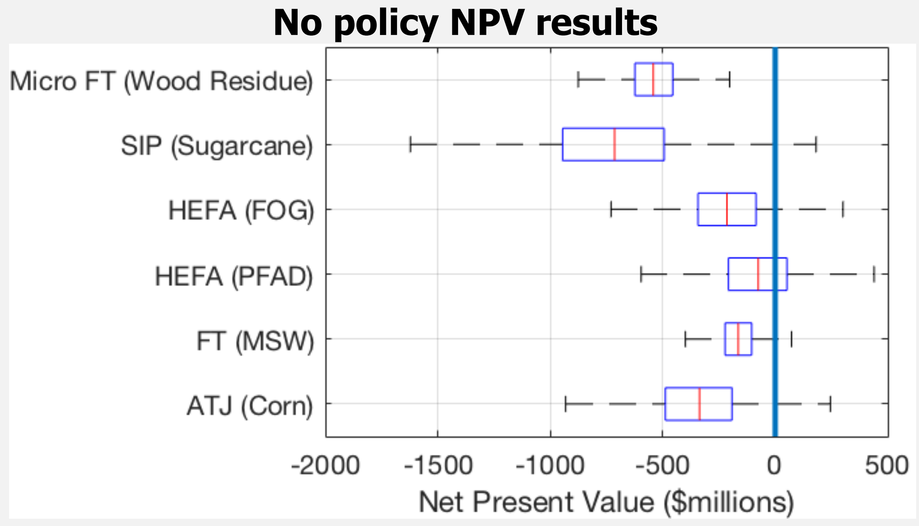
Methods

- 6 alternative jet fuel pathways were selected to represent technologies that are close to commercialization.
- Net present value (NPV) and Minimum Selling Price (MSP) were calculated as the metrics of economic viability.

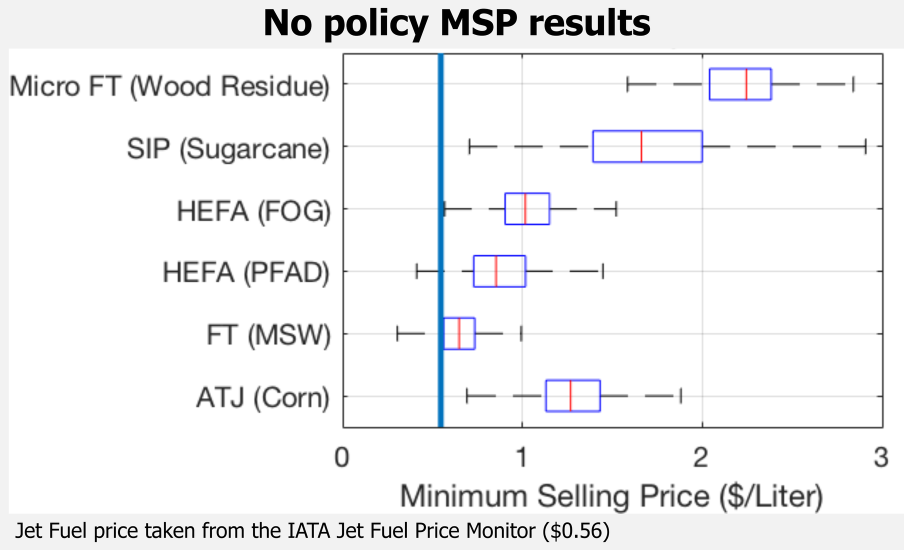
Stochastic TEA model



No policy NPV results



No policy MSP results



Jet Fuel price taken from the IATA Jet Fuel Price Monitor ($0.56)

Preliminary results. Please do not cite or quote.

Policy types assessed

Policy	Model implementation
Output based incentive (output subsidy)	A fixed monetary credit is applied on a per liter basis. All fuel products (not only jet) benefit from this policy.
Input subsidy	Feedstock costs are reduced by a fixed percentage (e.g. policy covers 10% of the feedstock cost regardless of price).
Capital grant	Reduces initial fixed capital investment. Awarded as a lump sum at the start of facility construction. The grant value does not exceed the total FCI of the facility.
GHG emission reduction-defined incentive	A monetary credit is applied, based on the amount of CO_2e reduced per liter of fuel. This is applied to all fuel products.

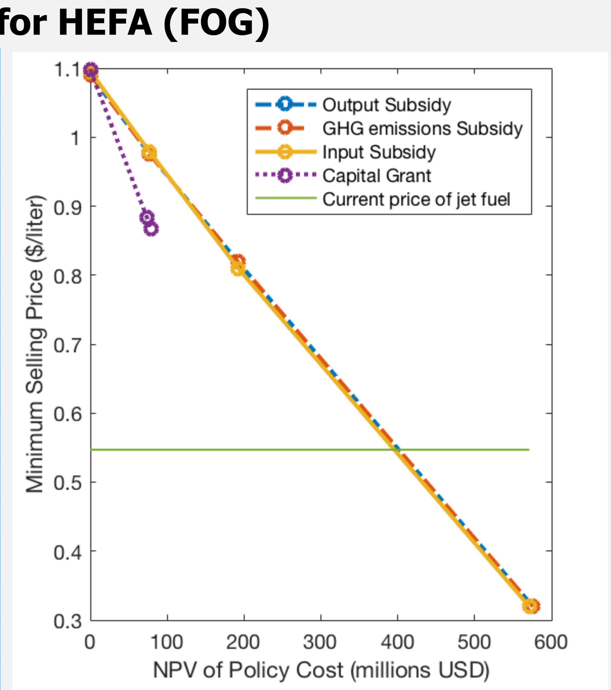
Results

Equal cost policy implementation

- In order to compare consistently between the different policy types, all four were implemented at equivalent total NPV cost to government.
- The corresponding impact of each policy on mean and variance of fuel MSP was calculated for each pathway.
- This was also done for different policy sizes.

Equal cost policies results for HEFA (FOG)

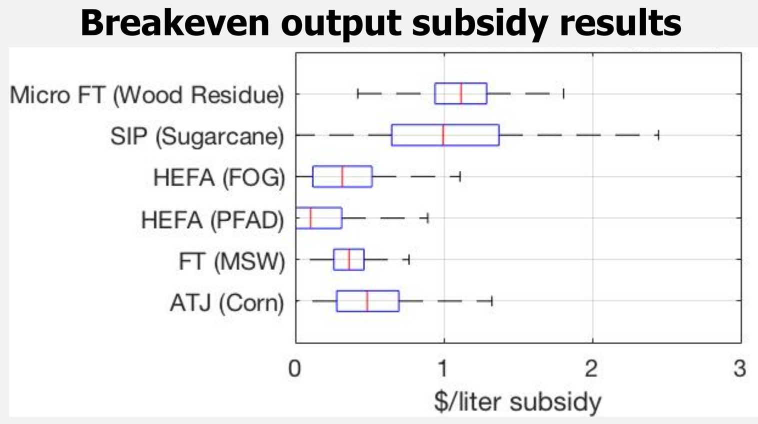
Output subsidy			
Policy ($/liter output subsidy)	0.10	0.25	0.75
Total policy cost (mil. USD) [std. dev.]	77 [3]	192 [8]	576 [23]
MSP ($/liter) [std. dev.]	0.97 [0.2]	0.82 [0.2]	0.32 [0.2]
Input subsidy			
Policy (% subsidy on feedstock costs)	16%	40%	119%
Total policy cost (mil. USD) [std. dev.]	77 [19]	192 [50]	571 [146]
MSP ($/liter) [std. dev.]	0.98 [0.2]	0.81 [0.1]	0.25 [0.1]
Capital grant (*max. value of the capital grant not allowed to exceed total FCI)			
Policy (capital grant in mil. USD)	77	79*	79*
Total policy cost (mil. USD) [std. dev.]	77 [4]	79 [9]	79 [9]
MSP ($/liter) [std. dev.]	0.88 [0.2]	0.87 [0.2]	0.87 [0.2]
GHG emissions reduction-based incentive			
Policy (USD/t CO_2e reduction credit)	48	114	343
Total policy cost (mil. USD) [std. dev.]	77 [3]	192 [8]	576 [23]
MSP ($/liter) [std. dev.]	0.97 [0.2]	0.82 [0.2]	0.32 [0.2]



Breakeven implementation

- The size of each policy that is required to achieve an NPV = 0 (the breakeven point) was calculated.
- Note that the capital grant value was not allowed to exceed total FCI. In all cases except FT (MSW), a capital grant ≤ FCI by itself is insufficient to achieve an NPV of 0.

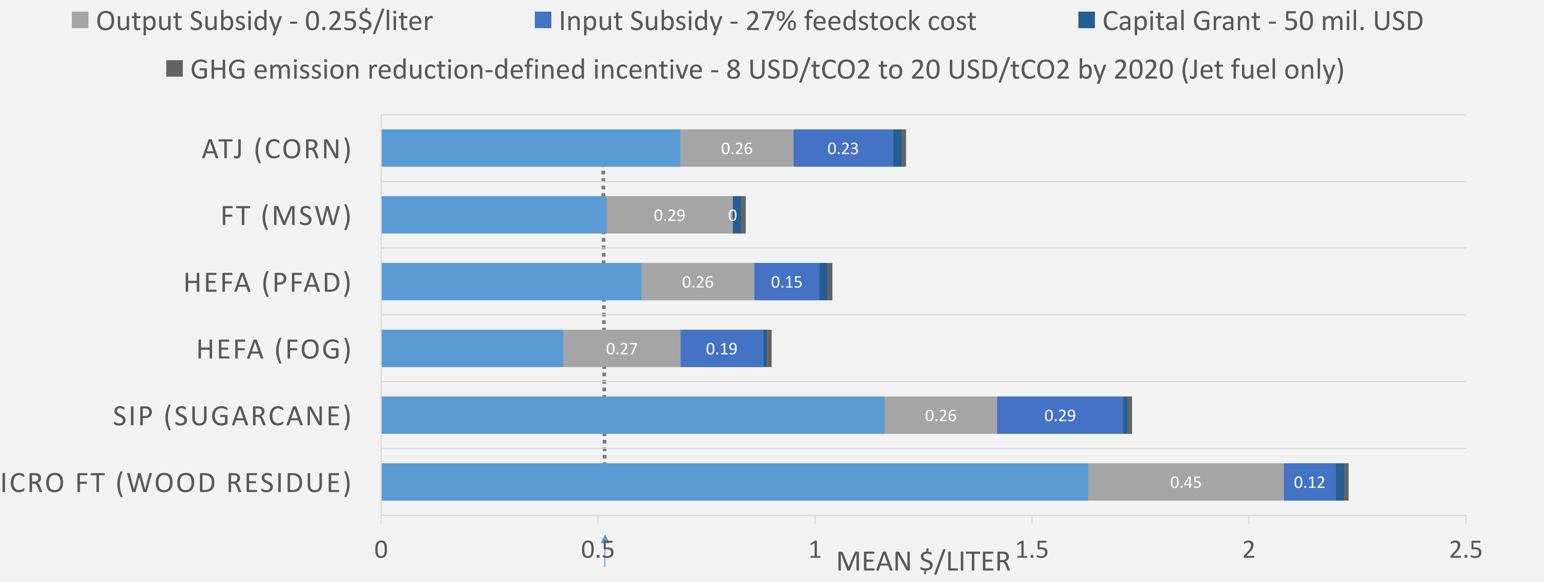
Breakeven output subsidy results



Policy	Output subsidy ($/liter)	Input subsidy (% feed. cost)	GHG emissions ($/t CO_2e)	Capital grant (mil. USD)
Micro FT (wood res.)	1.11	430	728	n/a
SIP (sugarcane)	1.05	93	815	n/a
HEFA (FOG)	0.34	47	154	n/a
HEFA (PFAD)	0.19	13	85	n/a
FT (MSW)	0.20	-	123	217
ATJ (Corn)	0.49	56	1077	n/a

Policy scenario implementation

- In order to evaluate the impact of real-world policies, one policy of each type was evaluated based on historical or existing biofuel policies.
- Note that these policies are additive: multiple policies may be implemented in parallel to reduce fuel MSP further.
- The plot below shows the MSP of each pathway along with how much the MSP is reduced by each one of the four policies.



Current Jet Fuel price taken from the IATA Jet Fuel Price Monitor ($0.56)

Preliminary results. Please do not cite or quote.

Discussion

- The policies' impact on mean MSP is linear. i.e. A policy that is twice as expensive results in a doubling of the reduction in MSP.
- The output subsidy, GHG emissions reduction-defined subsidy, and input subsidy, all have the same impact on mean MSP at equivalent policy costs.
- The manner in which a policy is implemented in the model has a significant impact on the results. For example, at equivalent NPV cost to government, a capital grant reduces mean MSP more than the other policies, because the monetary benefit is not taxed in the DCFROR model. In contrast, the input subsidy policy reduces MSP variance more than the others, as the policy bears some of the uncertainty in feedstock costs.
- All of the breakeven policies required for NPV = 0 are large relative to historical or existing policies.
- In the case of HEFA (FOG) and FT (MSW) fuels, a combination of real world policies results in a fuel MSP that is less than the price of petroleum jet fuel.

References

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Policy sources:

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GHG emissions reduction-defined incentive: GMTF cost-benefit analysis of CORSIA

Input Subsidy: Technical experts from Indonesia

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