

A Perspective on the Prospect of Reducing Advance Biofuel CAPEX and OPEX

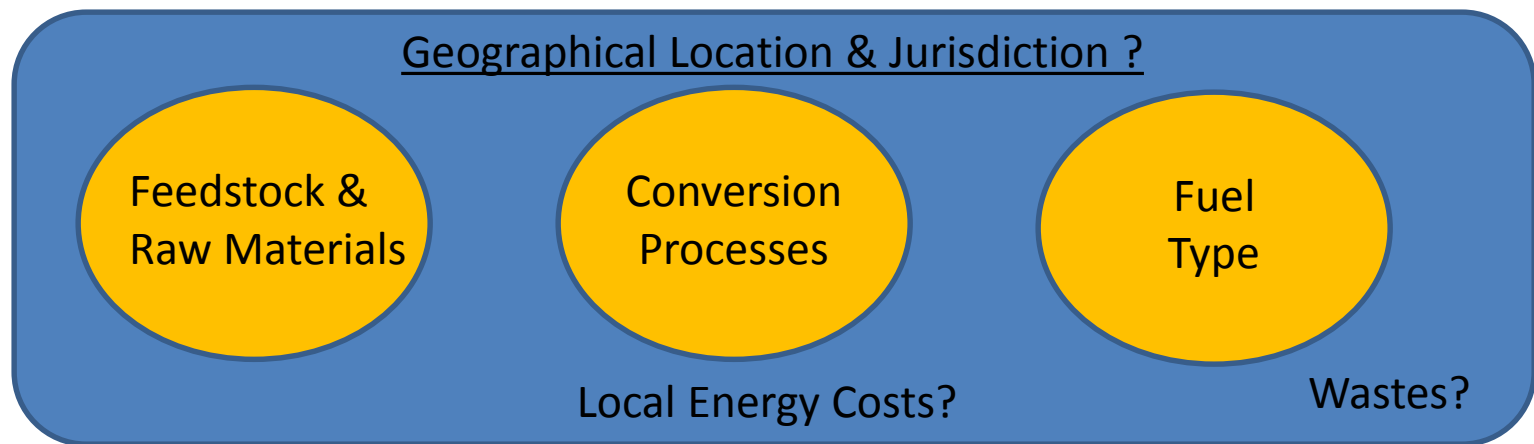
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Advance Biofuel CAPEX and OPEX

- Aim: Conduct feedstock-to-biofuel(s) supply chain analysis to identify CAPEX and OPEX cost reduction opportunities.
- Use Task 43 Feedstocks.
- Task 43 is “Biomass Feedstocks for Energy Markets”.



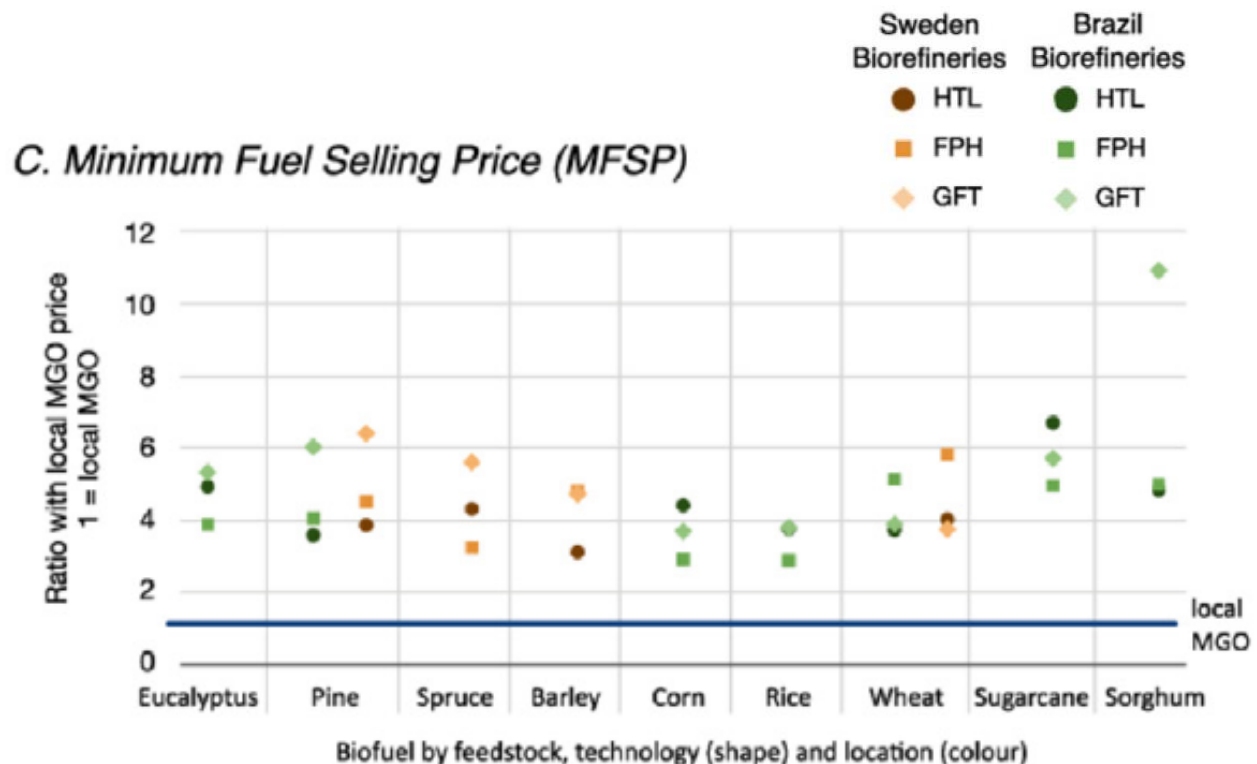
Lignocellulosic Marine Fuels - Tanzer et al.

- Techno-economic analysis case study of Marine Biofuel production in Brazil & Sweden.
- Marine Sector is 2-4% of World CO₂, 4-9% of SO₂ emissions.
- Key assumptions: well-to-wake analysis, 500 tonnes residues/day, fuel is 35 MJ/kg, 15 year life span, 50% contingency for CAPEX, 20% contingency for OPEX, centralised supply chain model, Marine Gas Oil sells at 14 USD/GJ.

3 Technologies for Lignocellulose-to-Fuel analyses for many Feedstocks

1. Hydrothermal liquefaction + hydrodeoxygenation.
2. Fast pyrolysis with + hydrodeoxygenation.
3. Gasification with Fischer-Tropsch synthesis (GFT) + H₂.

Conclusion: Sophisticated biofuels (> 45 USD/GJ) not cost-competitive with fossil incumbent (14 USD/GJ).

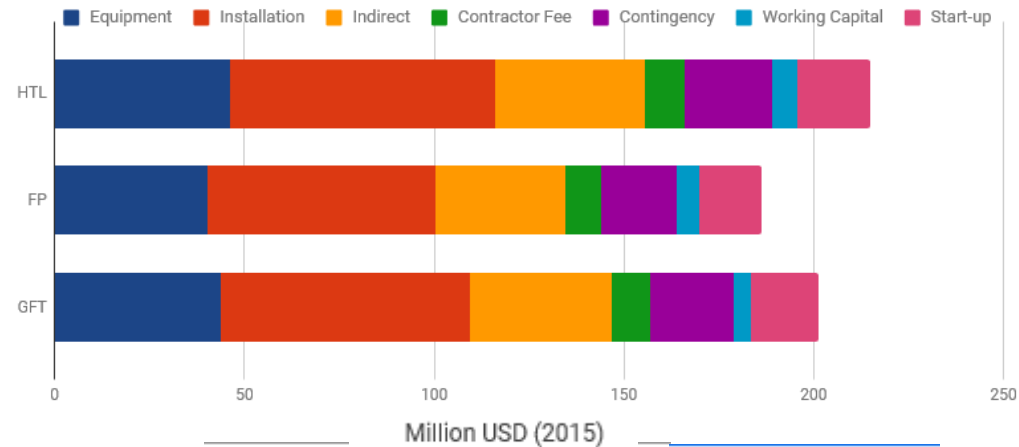


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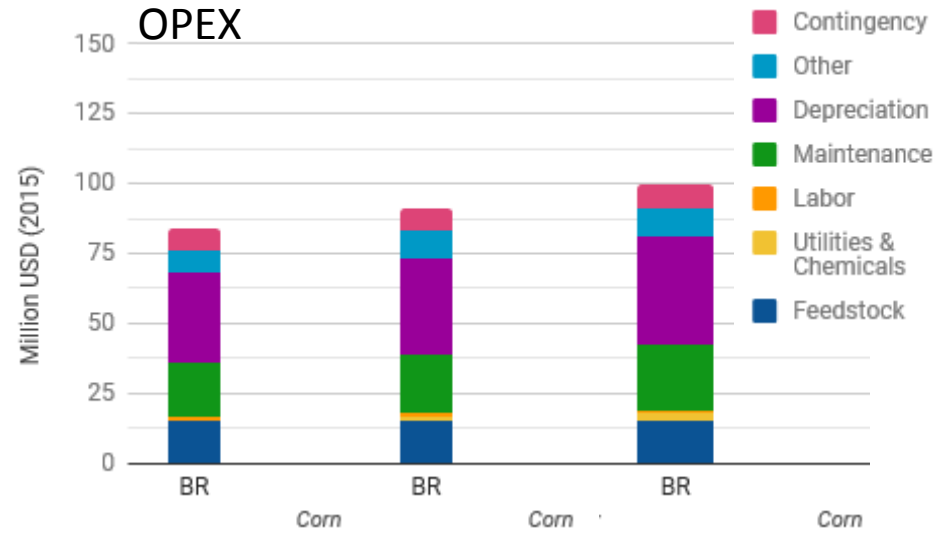
- Techno-economic analysis case study of Marine BioFuel production in Brazil & Sweden.
- CAPEX - Contingency will lower with experience of n^{th} plant.
- OPEX - Depreciation is a significant cost over the short 15 year plant life.

Exmple of Brazil – Corn Residue

CAPEX



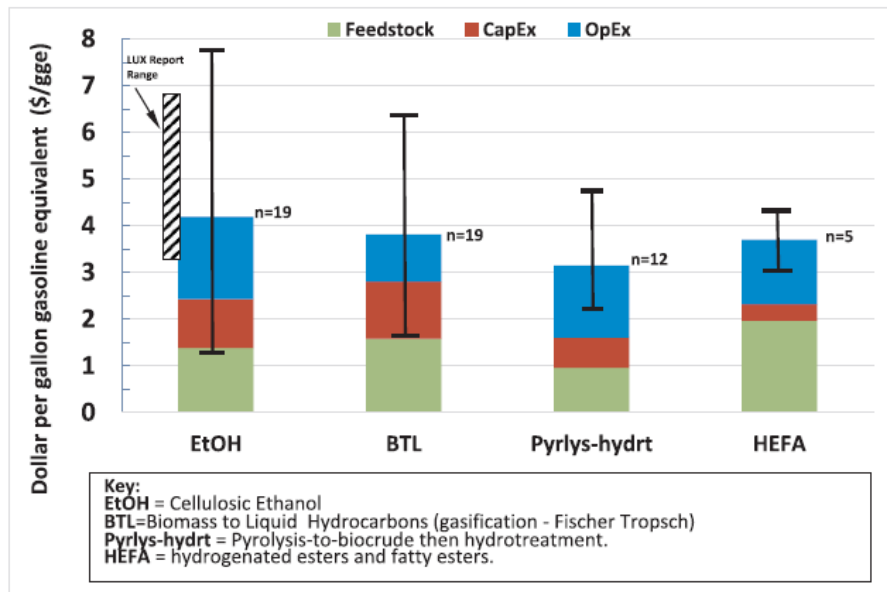
OPEX



Conclusion: Sophisticated biofuels (> 45 USD/GJ) not cost-competitive with fossil incumbent (14 USD/GJ).

Advance Biofuel Cost Estimates- Witcover et al.

- Costs of producing “advanced” USA biofuels (low GHG low ILUC) have not decreased in recent years as envisioned, despite aggressive policy incentives. Why is this?
- Wide variability in biofuel production cost estimates. Why is this?



Feedstock Prices

- Always significant, & increase with time/study.

HEFA CAPEX

- Low, due to 3/5 instances of co-location with petro refining.
- Low variability with time (indicating reliable/known).

BTL CAPEX

- Widely variable across 19 entries.
- Not variable with time (indicating unreliable/unknown).

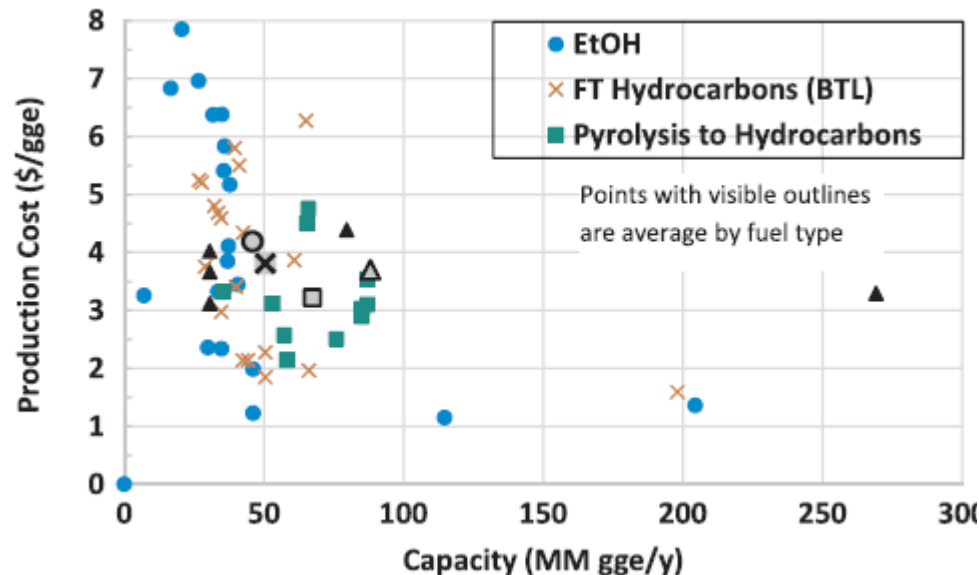
CAPEX/OPEX

- Little data on co-location other than HEFA.
- Presented data is for Greenfield scenario.
- Co-location & Co-processing have potential.

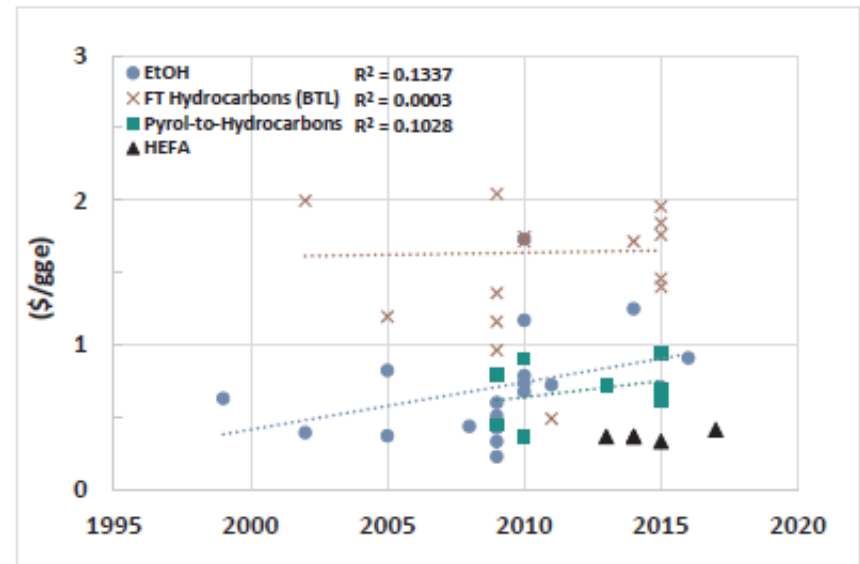
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Production costs do lower with economy of scale, but to a limit?



CAPEX estimates do not vary with time, HEFA < Ethanol < Pyrolysis < Gasification F-T

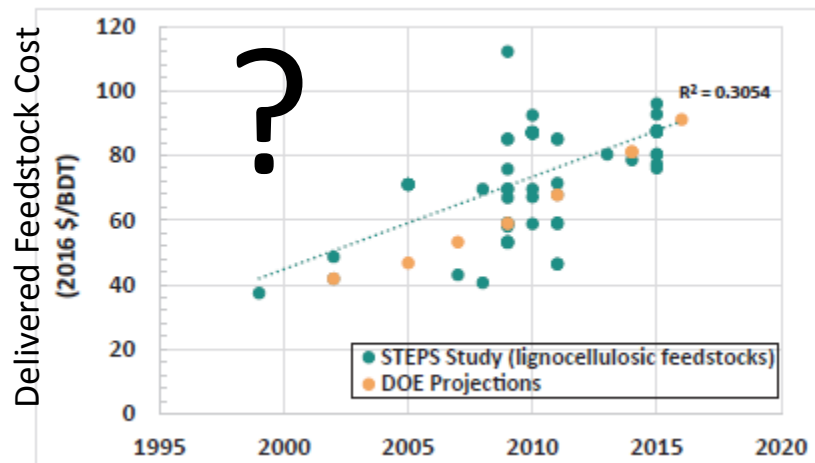


- Maybe CAPEX cannot show significant opportunities for reduction, other than co-location?

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OPEX estimates other than feedstock are typically not well detailed, and must be regarded as uncertain.



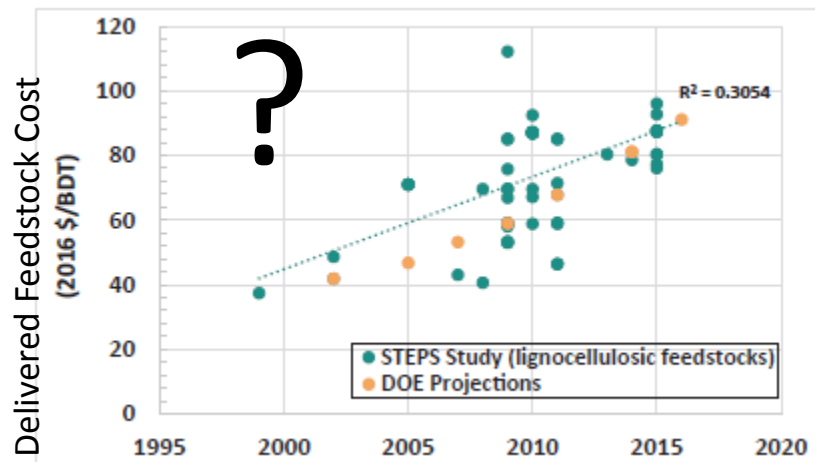
Cellulosic Ethanol Production Cost Estimate & Modelled Feedstock Price



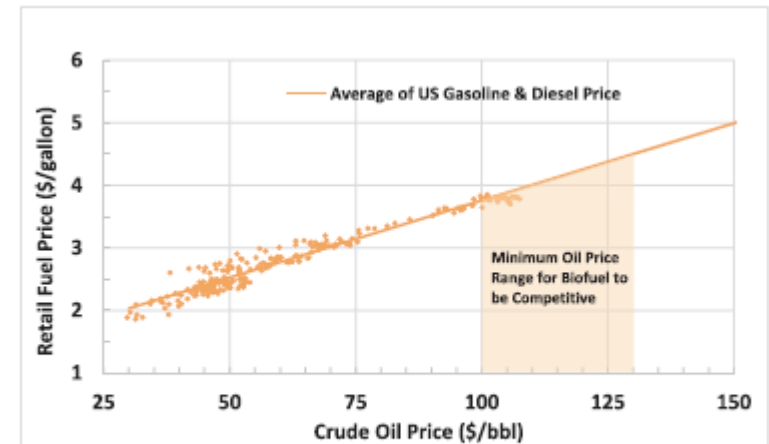
- Feedstock costs are “well known” and increasing with time.
- Why is this, supply & demand, better knowledge of market?

Advance Biofuel Cost Estimates- Witcover et al.

OPEX estimates other than feedstock are typically not well detailed, and must be regarded as uncertain.



Currently, advanced biofuels @ 3.8-4.1 \$/gge would require crude price of > 100 \$/bbl.



Note: US retail gasoline (regular grade) and diesel prices for 2014 – 2018 were averaged and plotted against West Texas Intermediate crude price

- **CAPEX** costs difficult to change, **OPEX** cost are poorly analysed and uncertain, **Feedstock Costs** are “well” known and increasing with time => focus on reducing feedstock costs?
- Actual case study data needed for co-location & co-processing.