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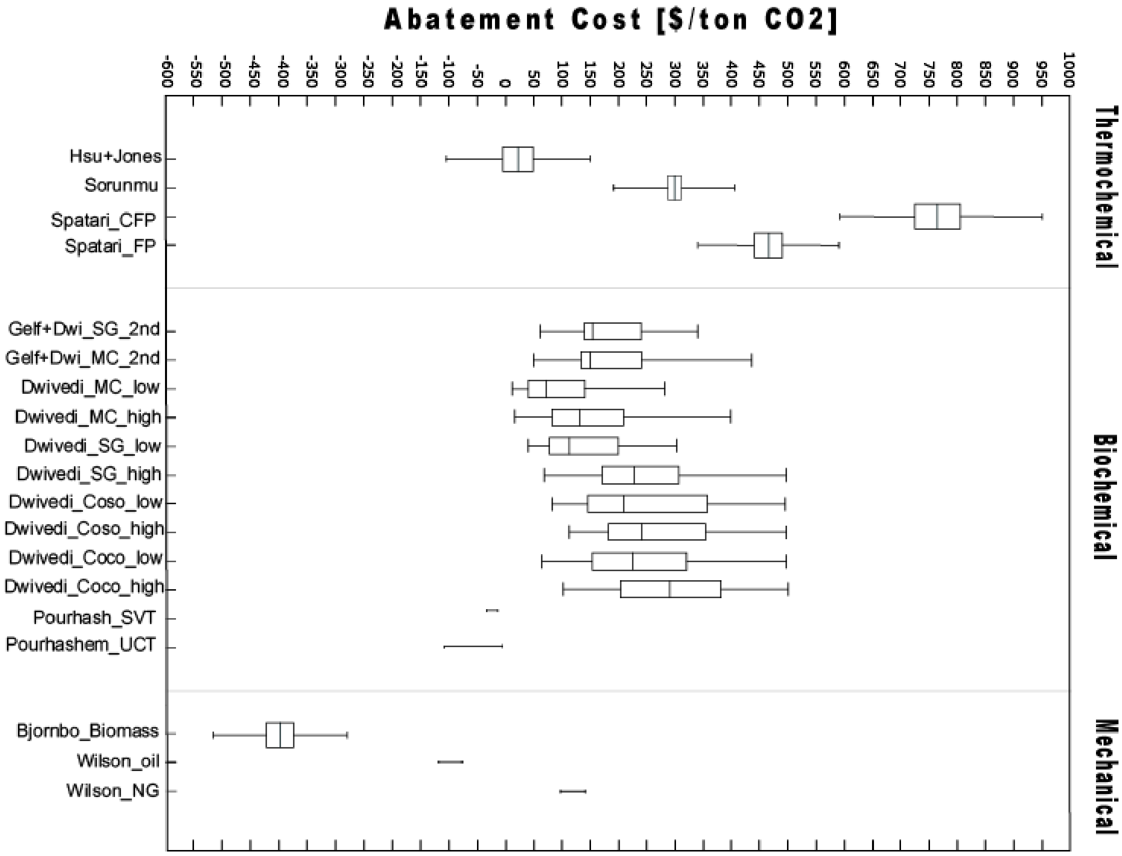
Probabilistic life cycle model using Matlab

Mitigating climate change and stabilizing global temperature rise to a safe limit is increasingly gaining worldwide attention and constitutes one of the biggest environmental concerns of this time. For reaching this target, offsetting fossil fuels and reducing greenhouse gas (GHG) emissions associated with energy use are required. Biofuels, liquid fuels derived from biomass resources, constitute a promising option for mitigating climate change.

Because biomass is a limited resource (land is a finite resource) and costlier than conventional fuels, understanding which technologies achieve the greatest reduction in greenhouse gas emissions at the lowest price (for economic feasibility), is critical for investment. This project aims to compare the performance between specific thermochemical, biochemical and mechanical processing regimes of second-generation biofuels (biofuels produced from non-food biomass resources such as sustainable forms of crop, animal, and forest residues).

The desire to achieve the greatest reduction in GHG emissions at the lowest price demands assessing each pathway's performance by calculating the cost effectiveness of GHG reduction, i.e., the abatement cost. Calculating the abatement cost is based on previously calculated global warming potentials (GWP) and costs found in the literature, based on life cycle and techno-economic analysis (LCA and TEA) of the conventional and alternative fuels. However, LCA and TEA models based on average numbers fail to predict verifiable real-world effects. Thus, feeding Monte-Carlo simulation values from probabilistic LCA and TEA models allows the evaluation of the performance of the technology studied in probabilistic terms, and hence allows the inclusion and presentation of real-world uncertainties. The project was done on Matlab software. The rusults are presented in the figure, where different boxplots represent different processing regimes.



Abatement Cost [$/ton CO2]
-600
-550
-500
-450
-400
-350
-300
-250
-200
-150
-100
-50
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
950
1000
Thermochemical
Hsu+Jones
Sorunmu
Spatari_CFP
Spatari_FP
Biochemical
Gelf+Dwi_SG_2nd
Gelf+Dwi_MC_2nd
Dwivedi_MC_low
Dwivedi_MC_high
Dwivedi_SG_low
Dwivedi_SG_high
Dwivedi_Coso_low
Dwivedi_Coso_high
Dwivedi_Coco_low
Dwivedi_Coco_high
Pourhash_SVT
Pourhashem_UCT
Mechanical
Bjornbo_Biomass
Wilson_oil
Wilson_NG