Modelling Uncertain Life-Cycle GHG Emissions from Biofuel Production

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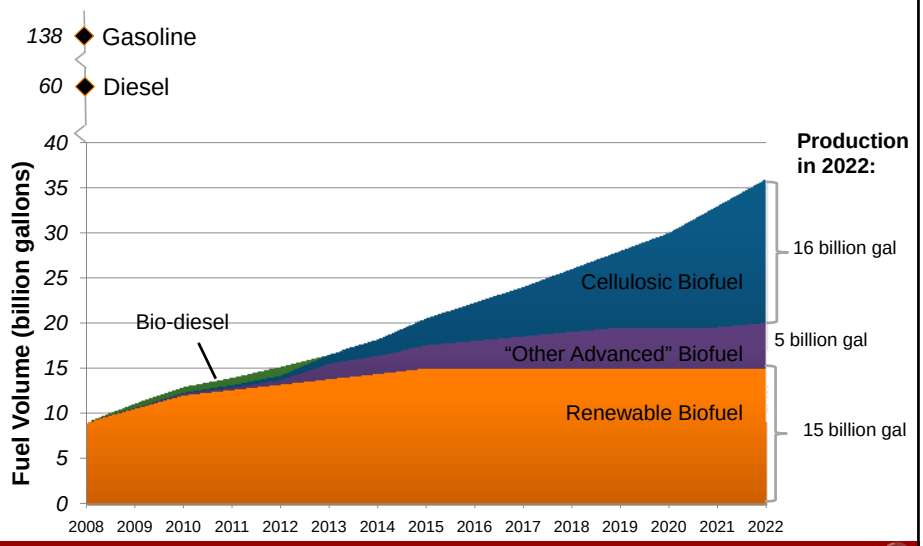
Energy Independence and Security Act 2007: Volume Goals



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Energy Independence and Security Act 2007: GHG Reduction Goals

Fuel Classification	% Decrease in Emissions	Baseline Fuel Type
Bio-diesel	50	Diesel
Renewable biofuel	**20**	Gasoline
Cellulosic biofuel	**60**	Gasoline
Other Advanced biofuel	50	Diesel/Gasoline

Project Motivation

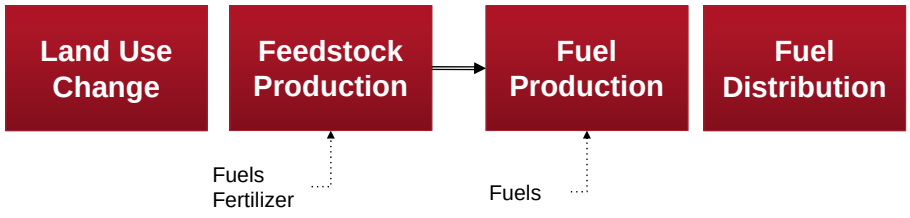
- Recent developments in policy (i.e EISA 2007) that require specific GHG reductions on a life-cycle basis
- Recent developments in next-generation biofuels research (new fuel types, new production methods)

Current models largely unable to deal with uncertainty inherent in projecting emissions from emerging technologies, so EISA compliance/contribution difficult to forecast

Methodology

- Streamlined, process-based life-cycle emissions inventory model
  - Focus on most important process steps from feedstock growth to fuel distribution w.r.t. greenhouse gas emissions
  - Functional unit: 1 MJ fuel
- Monte Carlo simulation for key input parameters
  - Goal is to identify influential parameters, propagation of uncertainty through to total emissions

Model Overview



Model Overview

Depends on **feedstock** type
Corn, Switchgrass

Land Use Change → **Feedstock Production** → **Fuel Production** → **Fuel Distribution**

Depends on **fuel** type
Ethanol, Butanol

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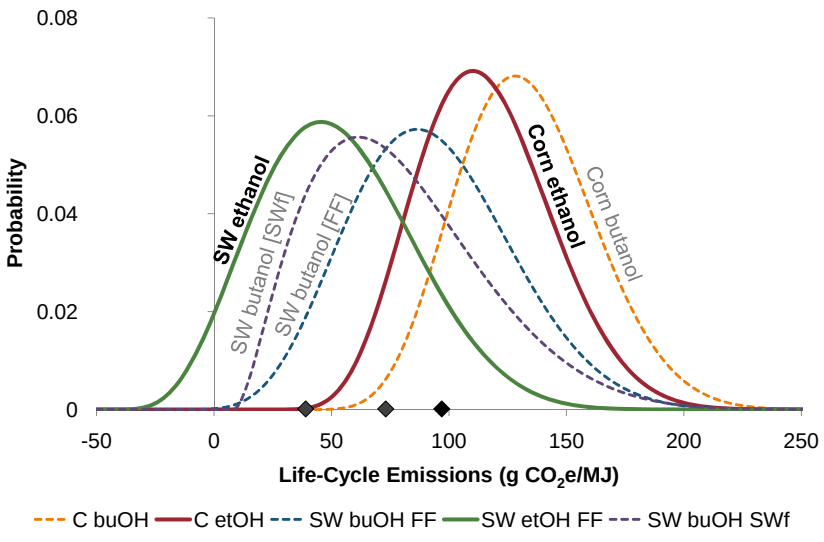
Total Emissions Distributions



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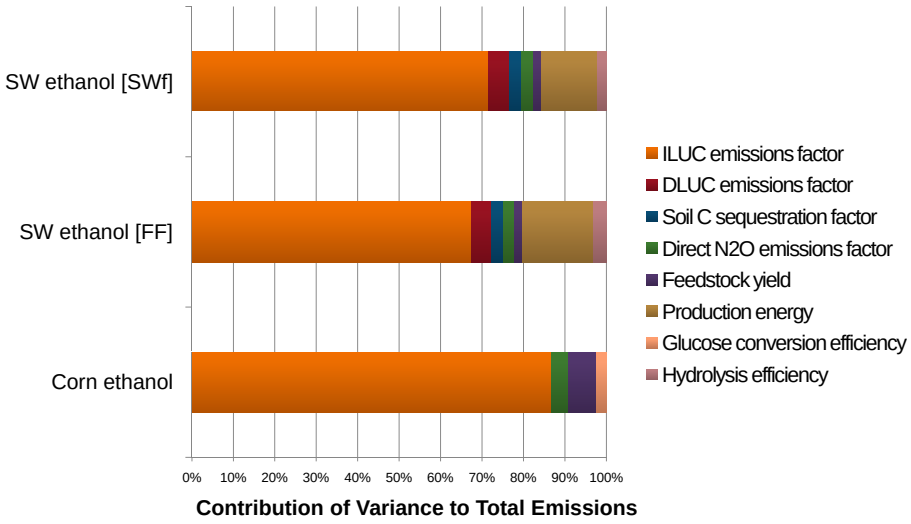
Output Sensitivity



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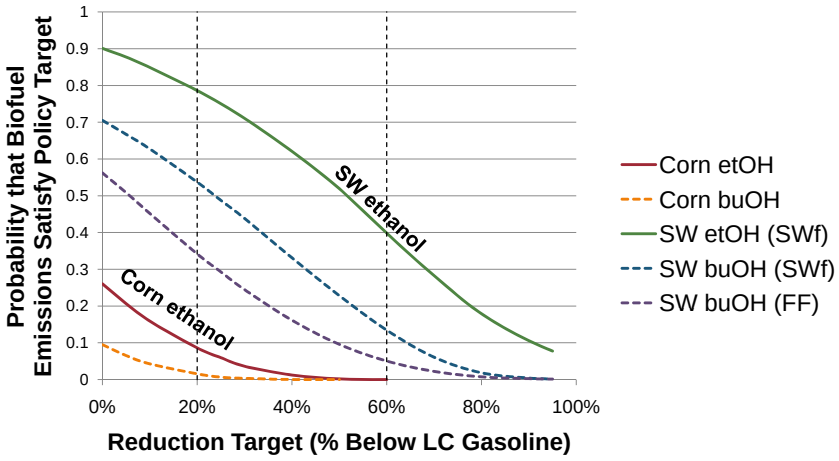
Comparing Biofuels to EISA Gasoline



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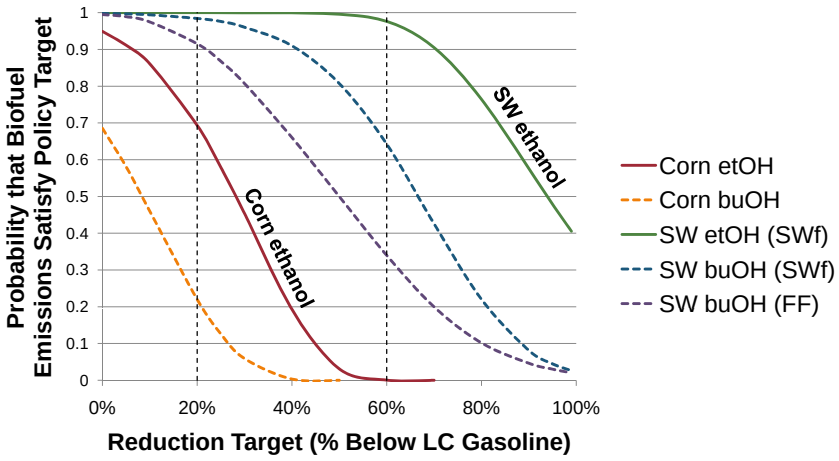
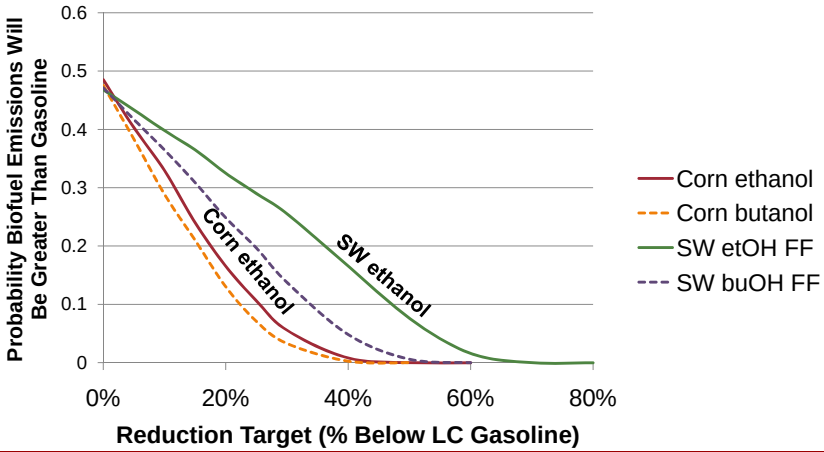
Biofuels without ILUC



Life-Cycle Emissions Policy Design Effectiveness

Probabilities of "False Positive" Given Policy Emissions Target Exactly Met



Conclusions

- Life-cycle emissions span an order of magnitude, so the degree of uncertainty is high
  - Current policy decisions are made based on point estimates, which ignores this
  - Land use emissions are most influential and most uncertain
- Trade-off between policy aggressiveness and level of confidence in actual emissions reductions
  - Consider strategy of choosing level of confidence, then selecting target emissions instead of degree of confidence being an unintended consequence of target

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