Sustainable Biofuel Supply Chain Planning and Management under Uncertainty

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Integrate “environmental thinking” in sustainable cellulosic biofuel supply chain planning and management; Develop a multi-objective modeling framework in achieving economic and environmental sustainability in biofuel supply chain system against uncertainty in conversion uncertainty; Use the proposed model to evaluate the economic potentials and environmental impacts for California cellulosic biofuel system development.

Background — Sustainable Cellulosic biofuel

- The majority of biofuels in US is corn grain-based biofuel obtained from food crops;
- Corn grain-based biofuel is not sustainable (pressure on food supply);
- Cellulosic biofuel is alternative to corn grain-based biofuel;
- Cellulosic biofuel is bio-wasted based biofuel and has better life cycle performance;
- Sustainable biofuel system: cost competitiveness v.s. environmental quality
- Uncertainty in conversion technology

Feedstock Types:
- Corn grain

Minimization of system greenhouse gas (GHG) emission (f)

Conversion technology with Dilute hydrolysis and fermentation

Ethanol Demand: 272 MGY in 2020

Conversion Technology: LignoCellulosics Ethanol (LCE) via hydrolysis and fermentation conversion technology with Dilute Acid pretreatment process

Feedstock Types:
- Corn stover, forest residues
- Refinery Capacity: 60-100MGY
- Demand Centers: 43 cities
- Transportation mode: Truck
- GHG data: GREET model

Minimize $f = \sum_{j=1}^{2} W_j \left( \frac{f_j(x^*)}{f_j(x)} - 1 \right)$

1) "Cost" 2) "GHG"

Example:

\[ \min f \Rightarrow x^* \quad \Rightarrow f^* \Rightarrow \text{optimal system cost} \]

\[ \min f \Rightarrow x^* \Rightarrow f^* \Rightarrow \text{anti-optimal system cost} \]

Construct the pay-off matrix following the example above and use attained four optimal and anti-optimal result to formulate the compromise model