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Quantifying Pathway Inputs

Ethanol 2016: Emerging Issues Forum

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SMART Pathways

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Specific

Measurable

Attainable

Results oriented

Time specific

Be SMART in creating pathways to market

Introduction

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High level elements for quantifying pathways inputs are covered in this presentation, as well as potential benefits for investment and development including:

- Inputs (Feedstock, energy, and chemical)
- Outputs (Product and co-product yields)
- Carbon Intensity (CI) of a product or co-product
- Impacts on financial viability

Quantify Pathways to Maximize Market Potential

Ethanol Block Diagram

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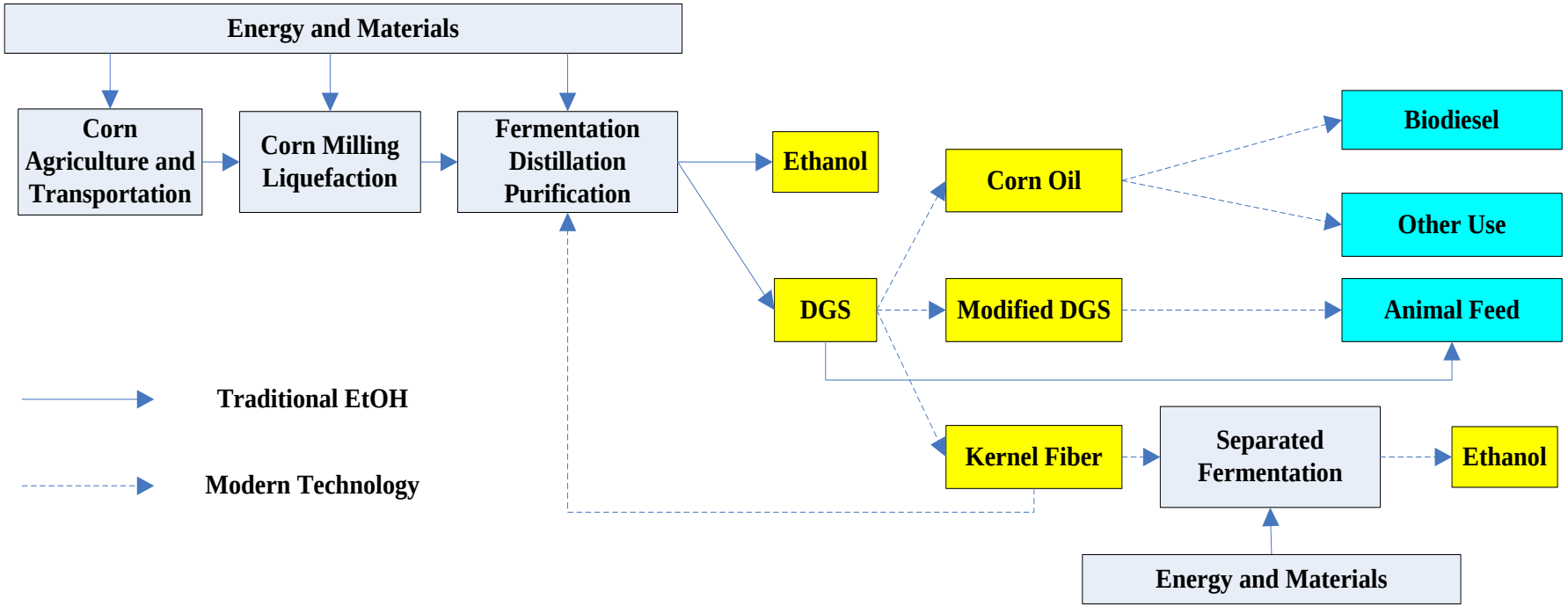

Note: Kernel fiber and/or corn oil could be separated at front end before starch fermentation, not shown here.

Verify RFS and LCFS Pathways to Protect Investment

Co-Processing D3/D6 Fuel

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Co-Processing D3 and D6 Fuels at the same Starch Ethanol facility is possible through emerging technologies, including:

- Co-Fermentation
- Separate Hydrolysis and Fermentation

Benefits:

- RFS Pathways 2 Kernel Fiber Pathway
- Additional fuel from the same feedstocks
- Monetize D3 and LCFS credits
- Cellulosic tax credit

Recommend separate D3 Pathway for transport of only D3 Gallons

D6 Starch EtOH Chart

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Parameters	Natural Gas	Electricity
Assumed usage	24,000 btu/gal	0.75 kwh/gal
Contribution to CI of ethanol (g CO2e/MJ)	21 (Biogas, Biomass, CHP, efficiency)	6 (Solar, wind, CHP, efficiency)
$/gal value for 50% reduction based on $100/MT CO2 LCFS credit	$0.085	$0.024
$/100 MGY value for 50% reduction based on $100/MT CO2 LCFS credit	$8,455,650	$2,415,900

Understand Market Potential

D3 Cellulosic EtOH Chart

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Parameters	2-7% additional D3 EtOH
CI (g CO2/MJ)	<40
CI from iLUC	0
$/gal LCFS credit value based on CI=20 to CI=40 and LCFS credit =$100/MT CO2	$0.47 - $0.63
Additional $ value for a 100MGY D6 EtOH plant	$0.9 M- $4.4 M

Separate score for D3 for shipping, for LCFS program

D3 Quantification Examples

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Generally, there are three protocols used to calculate the CI of D3 gallons in GREET Modeling:

1. **Separate all inputs** used to calculate the CI including energy use, chemical use, etc.
2. Develop an **allocation protocol** to assign process inputs to D3 and D6 gallons based on usage
3. Use a **marginal method** comparing the data collected before and after the D3 ethanol system is bolted on and used at the facility

Choose based on plant and market and collaboration with CA ARB

Co-processing Web Solutions

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Kernel Fiber Now					
Profiles	Propose	Activate	Current		
D3 Ledger		Batch Results	D3 Ledger		
Results				Analyses	
Quality					QC or Q-RIN
Notifications	10 Day	500K Gal	Tank Heel	500K Gal	500K Gal
Records	System of Record	System of Record	System of Record	System of Record	System of Record
RFS 2 Requirement	**Technology**	**Producer**	**Marketer**	**Lab**	**Quality**

Protect value of Ethanol Industry D3 RINs

A Leader in Carbon Credit Realization

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9.2 MILLION RINs PROCESSED **EACH DAY** on our automated platform

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Thank you!

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