Feedstocks: Developing a Successful Strategy to Operate a Supply Chain

Equinox

Kyle Althoff

President

kalthoff@equinox8.com

+1 303-910-6052

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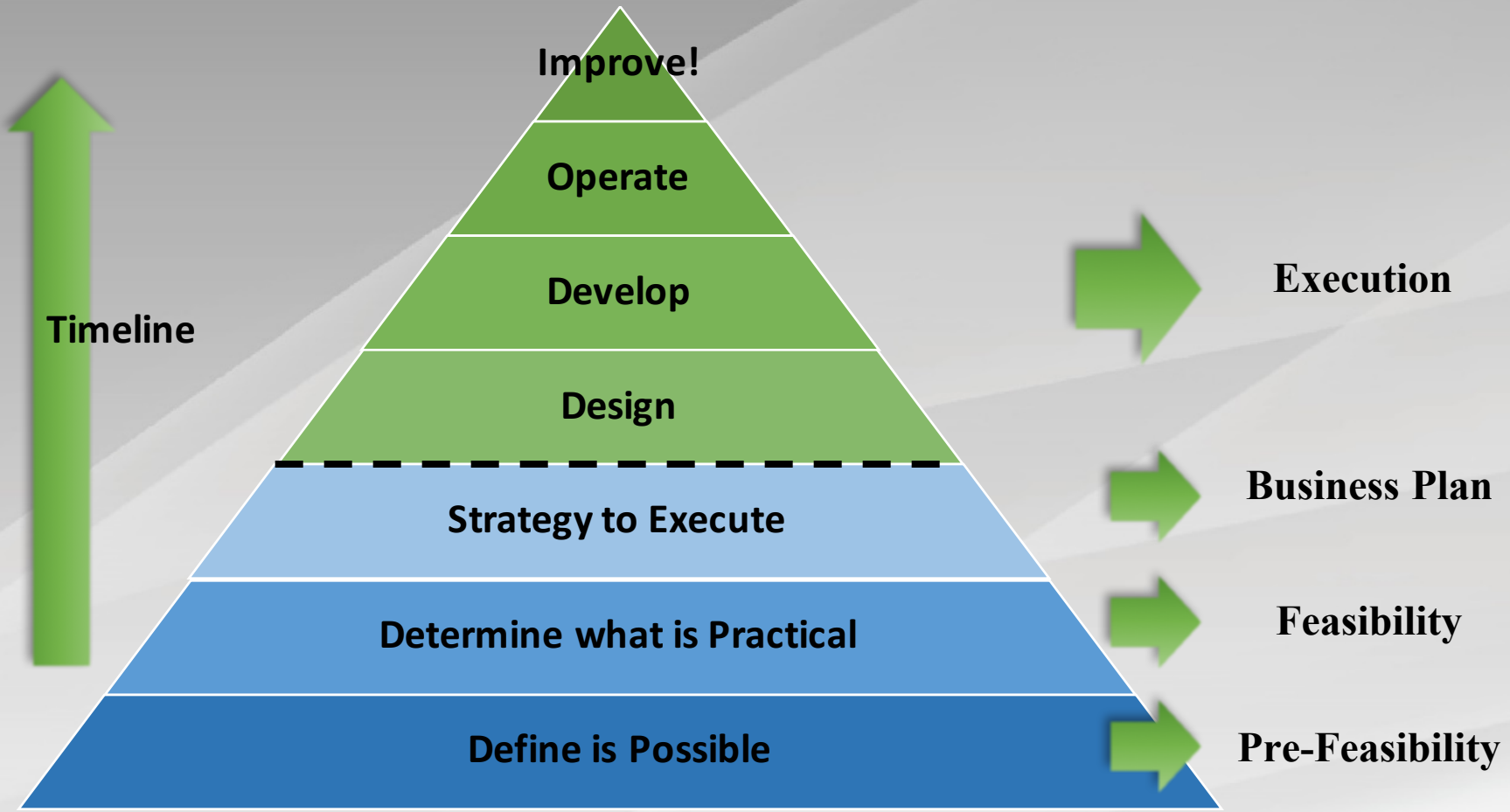
Bio-conversion Project Development Steps

1. Business formation
2. **Conduct a feasibility study**
3. **Feedstock Supply & Market Analysis**
4. Develop a business plan
5. Fund initial development
6. Choose process technology
7. Select design/builder and complete preliminary design
8. Select site
9. Apply for air permit
8. Raise balance of equity
9. Negotiate marketing agreements
10. Negotiate utility and transportation agreements
11. Select risk management firm
12. Obtain debt financing/financial close
13. Hire a project construction manager
14. Begin construction and startup

Supply Chain Development



Biofuel Financing - Feedstocks

Introduction

Feedstock Risk

Objectives

Plan & Structure

Align feedstock supply, process technology, project structure, and operations to create financial success!

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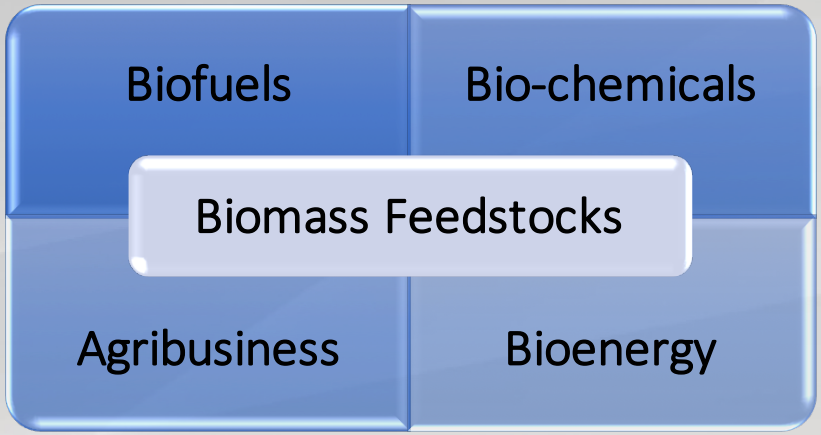
Bio-conversion & Agribusiness Consulting

- Biomass Supply Chain Development
- Biofuel Project Development
- Financial Validation
- Feasibility Studies
- Market Analysis
- Economic Impact Analysis
- Due Diligence for Financing



Providing experienced advice, exceptional analytics and strategic development for the bio-conversion and agribusiness industry.

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1. Risk in the Supply Chain

There is typically RISK in many biomass projects regarding:

- Feedstock yield
- Feedstock quality & composition
- Feedstock delivery – quantity and schedule
- Project timeline – plant startup and feedstock scale up
- Process technology capabilities
- Plant operations
- Financing Risk
- Risk Management needs to be integrated into Operations

Establish a comprehensive Strategy that addresses these risks for your project to expand your opportunity for success.

Feedstock Supply Chain Costs:

- If a biomass supply chain is not developed and managed appropriately, it can cause severe disruptions in operations and result in massive financial losses.

Feedstock Annual Cost	Starch	Cellulose
Plant Size	30 MMGY	30 MMGY
Unit Cost	$4.00 per bushel	$80 per US ton
Conversion Yield	2.80 gallons/bu	75.00 gallons/ton
% of Total Costs	75%	50%
Cost in $ per Gallon	$1.43	$1.07
Cost in $ per Liter	$0.38	$0.28
Total Cost per Year	$42,857,143	$32,000,000

10% change in feedstock at $80/dry ton is $0.10 per gallon on a 30 MMGY plant = $3,000,000 per year

Supply Chain is an Agricultural System

- Agricultural systems are biological, subject to risk from disease, weather, insects/pests, and other factors
- There will be year-to-year variability in cost due to these factors
  - Can lead to plant shutdown
  - Inventory is one option to mitigate
  - Secondary crop is another option to help

Develop a plan that helps to address these risks, re-evaluate as new information is gathered

What are the Risks?

= **Failure to Operate!**

Feedstock Risk in 2nd Gen Biofuels

- Cellulosic crops like switchgrass, miscanthus, new oil crops, plus crop residues
- Feedstocks may not widely available today – not a commodity
- Feedstocks have risk with development, inventory, cost, quality, and delivery
- Some feedstocks offer opportunity for longer term contracts to mitigate cross commodity price risk of 1st Gen biofuels like corn and wheat

Crop Residue Supply Chain

Direct Harvest

Grain Harvest

Stored Biomass

Residue Harvest	Transport	Storage	Delivery	Biorefinery
• Cut/Windrow • Bale • Stack	• Load • Transport	• Unload • Stack	• Transport • Unload	

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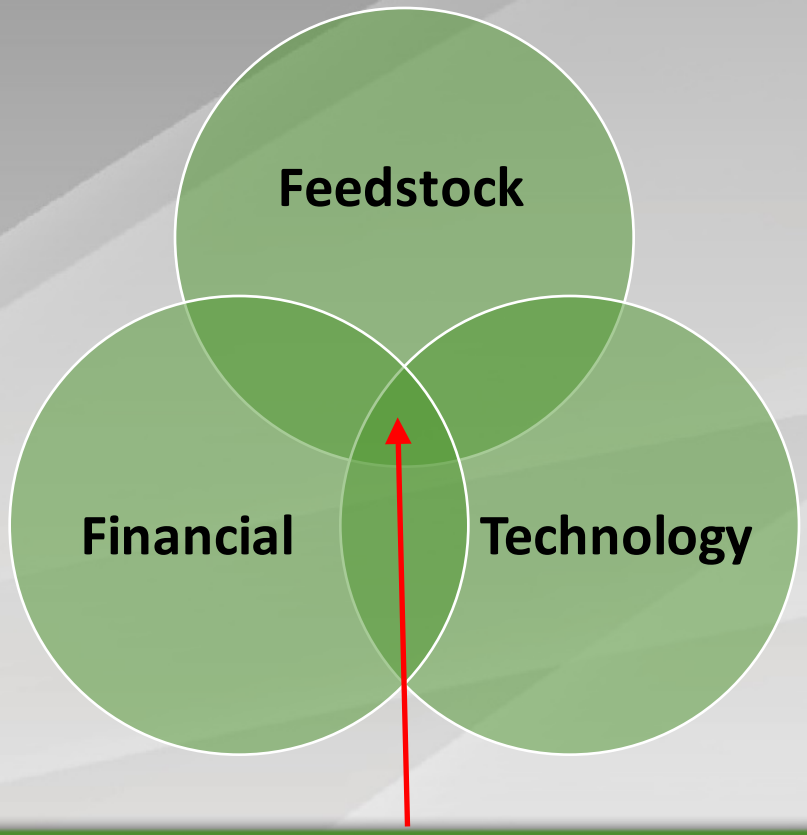
2. Feedstock Objectives



Successful projects mitigate risk in these 3 areas by developing an economic and environmentally sustainable Feedstock Supply Chain

Supply Chain Objectives

Develop & operate economically competitive and sustainable Feedstock Supply Chains

Quality
Cost
Delivery

Bio-conversion operations must be capable of mitigating and managing risk in each of these categories

Supply Chain Objectives

QCD

1. Quality
2. Cost
3. Delivery
   - Quantity
   - Schedule

Example:

The process economics are optimized and can operate sustainably using a:

- Herbaceous feedstock at < 60% moisture with under 5% acids
- < $80 per dry ton at 55% carbohydrates
- Using existing collection methods delivered year-round at 2000 dry tons per day.
- Can be achieved with high regard to safety and morale for internal team, partners, and external stakeholders.

Feedstock Delivery/Supply

- Evaluate local and regional potential
  - Existing availability
    - Historical changes
  - Potential availability
    - Resources required
- Develop assurance for long term supply
  - Contract direct with farmers, harvesters, and/or coop
  - Vertically integrate upstream in the supply chain
  - Partnerships

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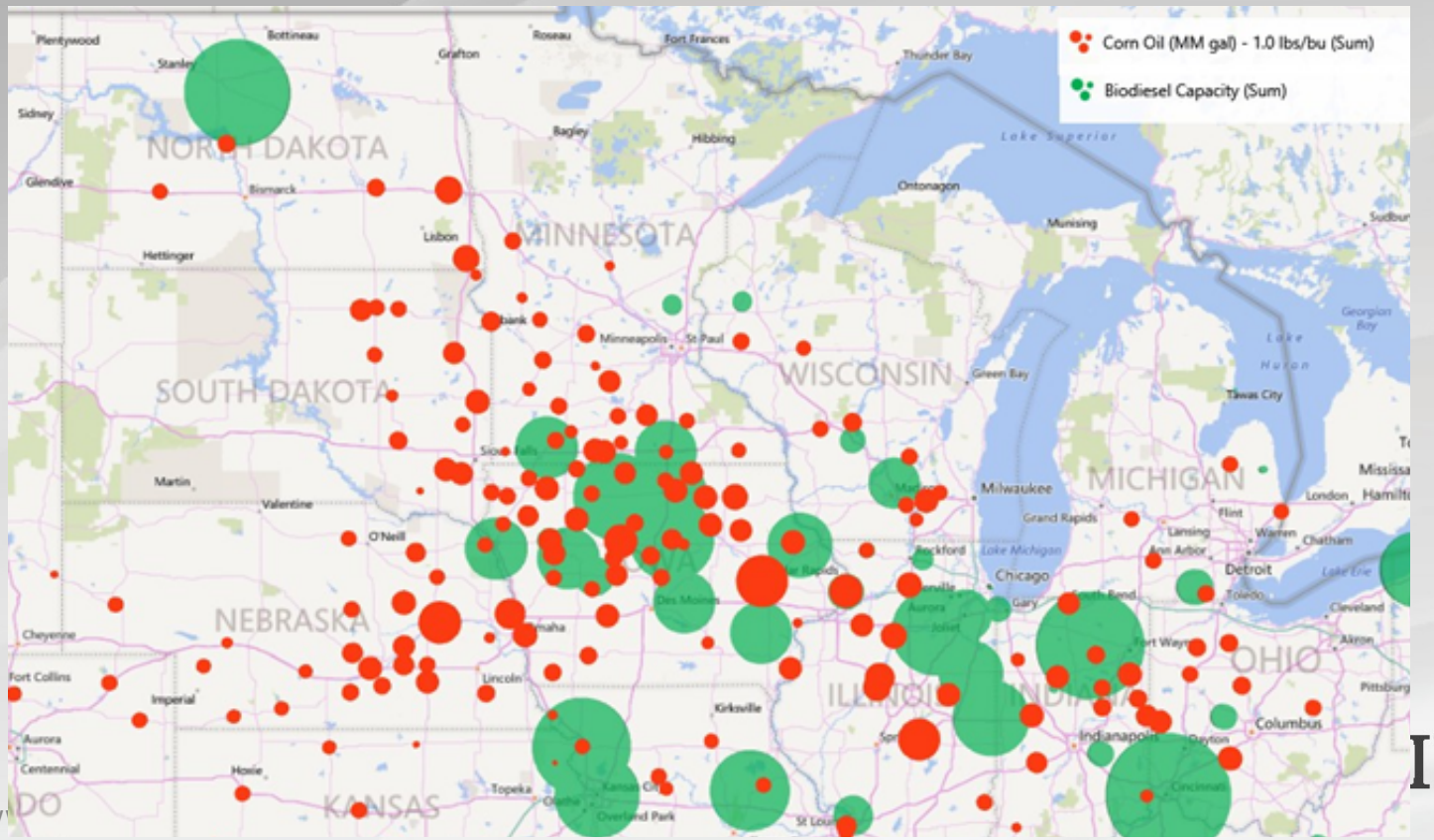
Quantity - What is the market assessment for feedstock supply?

- Local, Regional, and National supply for feedstocks
- Competing demands for feedstocks



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Feedstock Supply Chain Volumes

Biorefinery Volumes	US	Metric
Biorefinery Output Size	**30 Million gallons**	**114 Million liters**
Equivalent Size	714,286 barrels	89,635 Metric tons
Corn Grain		
Corn Starch Feedstock	10,909,000 bushels	277,000 Metric tons
Corn Starch Land	72,727 acres	73,000 hectares
Cellulosic Feedstock		
Cellulose Feedstock Size	400,000 dry US tons	362,878 metric tons
Dedicated Energy Crops	**57,000 acres**	**23,000 hectares**
Crop Residues	**200,000 acres**	**81,000 hectares**
Truckloads to Plant per Year	**19,000 truckloads**	
Bales per Year	**728,000 bales**	

The supply chain does not appear overnight, and it requires continual optimization once operational

Feedstock Cost Analysis

- Feedstock(s)
- Cost of Production
  - Land Rental
  - Establishment
  - Crop Growth & Production
  - Harvest
  - Transportation
  - Storage
  - Delivery
- Crop Yields
- Inventory

- Startup Costs
  - Working capital
  - Assets
- Competing Markets
- Variability in Feedstock and Plant Operations

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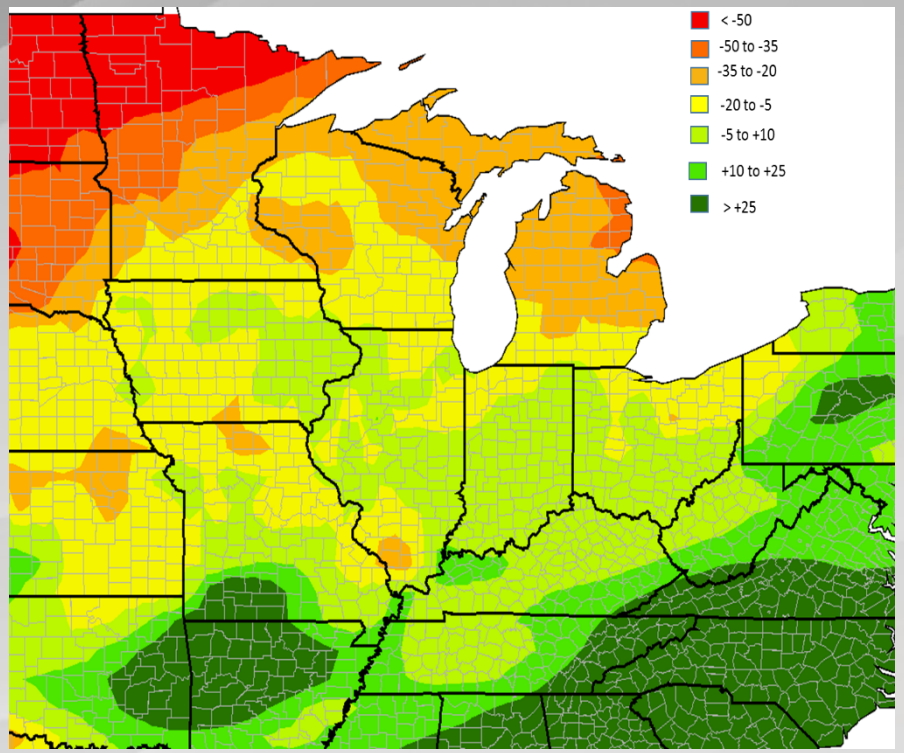
How Competitive is Your Feedstock?

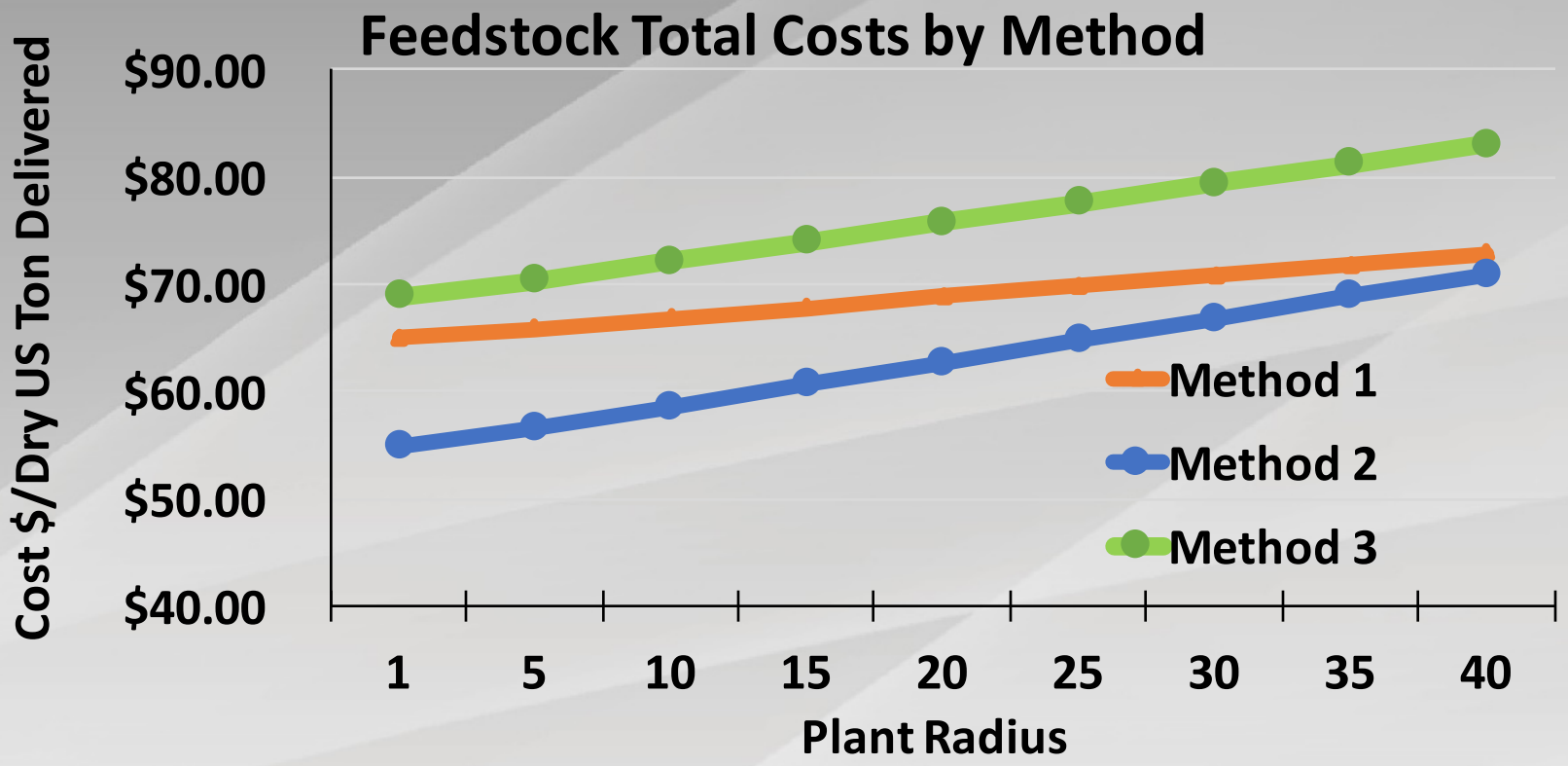
- Land Rental
- Establishment Costs
- Cost of Production
- Harvesting
- Transportation
- Storage
- Crop Yields



$0.10 per gallon on 100 MMGY plant is $10,000,000 per year

Projects may have 10-30 Year Fixed Assets – how will markets change?

What Feedstock is Least Cost?



The answer depends on several factors - whether supply chain can harvest directly or requires storage, and what distance the land is available by each crop

Feedstock Quality

- Carbohydrate
- Energy Content/BTUs
- Moisture
- Dirt
- Other contaminants
- Ash
- Lignin
- Inhibitors
- Artifacts from Storage

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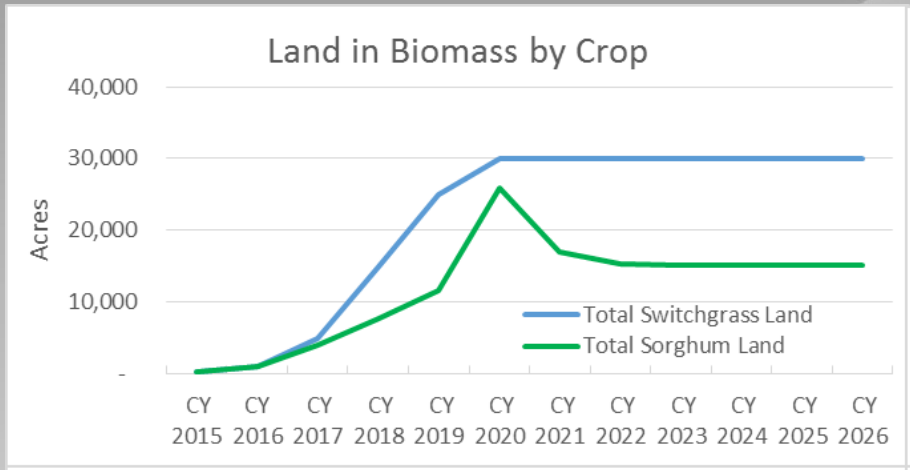
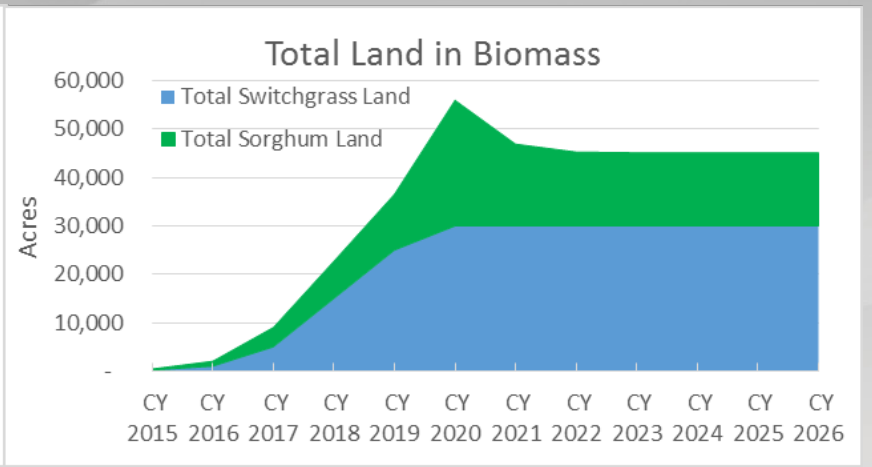
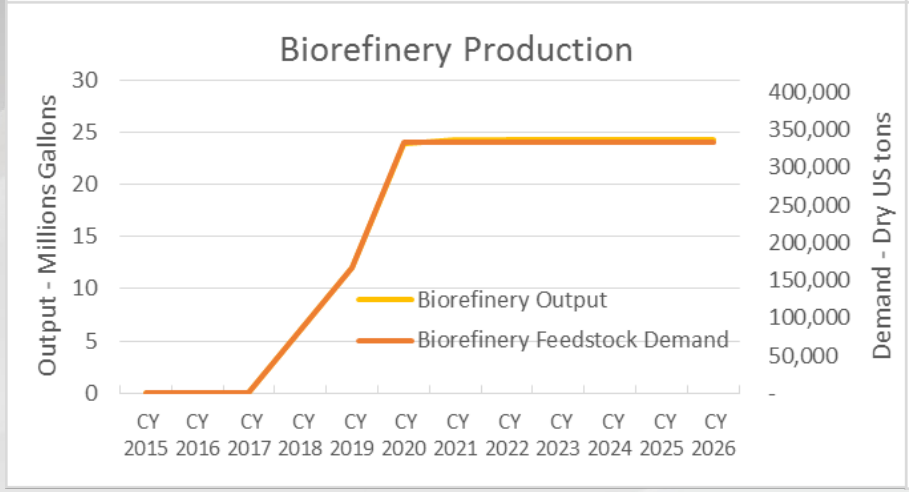
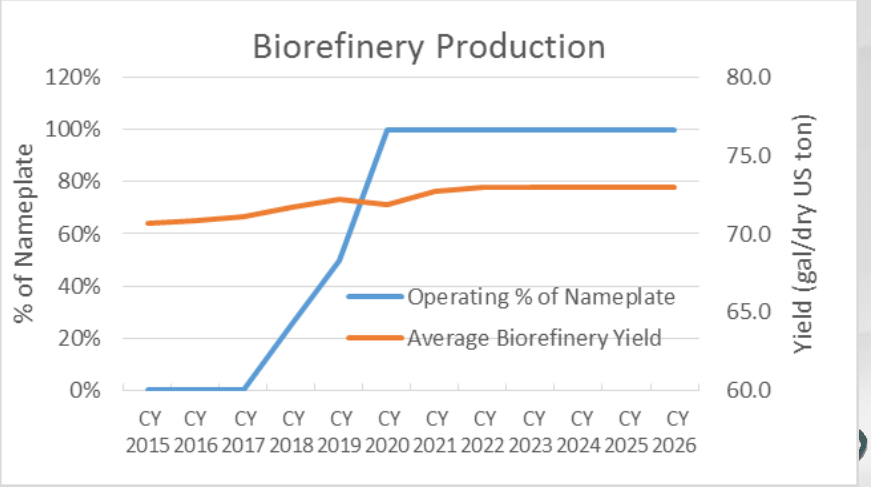
Performance & Benchmarking









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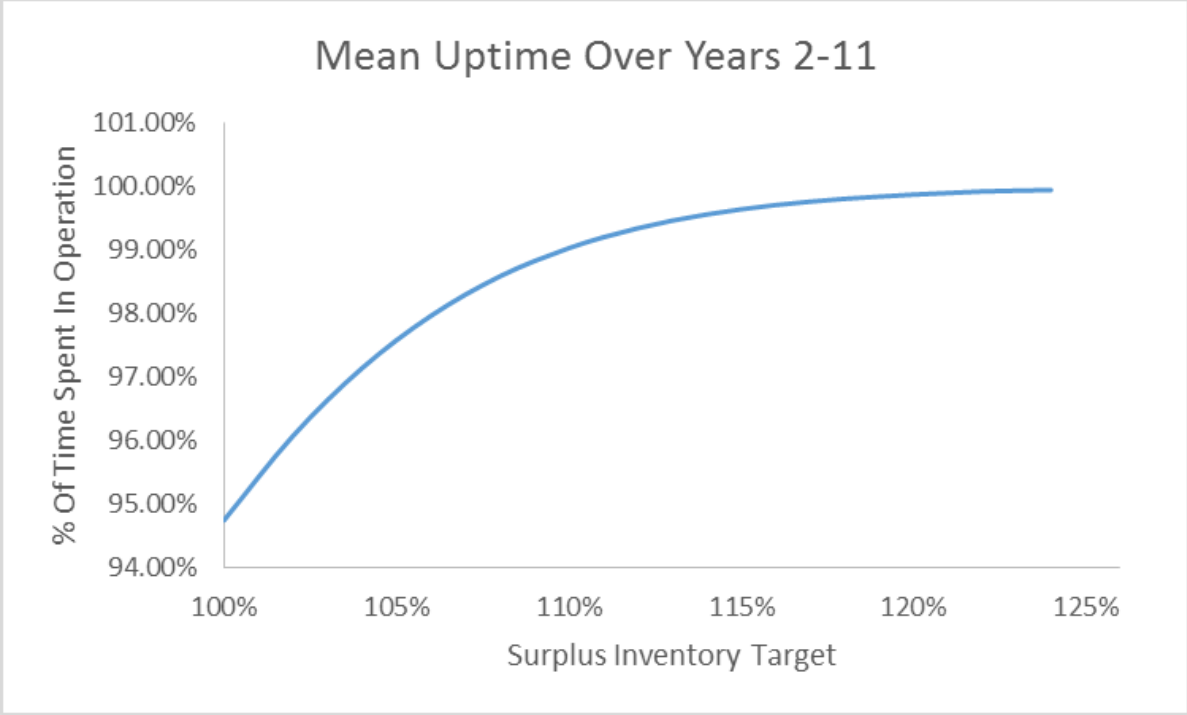
Risk Assessment & Mitigation

- Integrate Risk Assessment and Mitigation into the Strategy
- Example: Examine options to implement multi-crop strategy to manage inventory on a yearly basis



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3. Supply Chain Plan & Strategy

- Integrate the supply chain objectives into a coordinated plan and strategy for feedstock supply chain to operate while managing risk
- Use structure(s) that will enable the feedstock supply chain to deliver on the project goals:
  - Business Structure (vertical integration, coops, farmer model)
  - Capital Structure (leasing equipment, rental, ownership)
  - Operational Structure (supplier performance requirements)

Feedstock – What is the Plan?

- Project & Location description
- Overview feedstock supply chain
- Feedstock supply availability
- Feedstock Production
- Feedstock Collection
- Feedstock storage
- Feedstock delivery to biorefinery
- Preprocessing
- Operations and Logistics
- Feedstock quality control
- Feedstock supply chain management
- Risk analysis
- Government policy & regulations
- Sustainability
- Project Schedule
- Preliminary cost analysis
- Government incentives
- Financing

Feedstock Supply Chain Strategy is critical to project success

Structuring the Biomass Supply Chain

- Use structure(s) that will enable the feedstock supply chain to deliver on the project goals:
  - Business Structure (vertical integration, coops, farmer model)
  - Capital Structure (leasing equipment, rental, ownership)
  - Operational Structure (supplier performance requirements)

Structuring the Biomass Supply Chain

Establishment | Crop Production | Harvest | Transport | Storage | Delivery

Integration of Supply Chain with Biofuel Facility

Independent Suppliers (farmer model)

Partial ownership/control of supply chain

Vertically integrated supply chain

Conclusion
Biofuel Feedstocks - Financing

1. Understand the Risk for Financing and Operation
   - 2nd Generation Feedstocks are unique and present different financing risk
2. Define the Objectives – Quality, Cost, Delivery (QCD)
3. Develop Strategy to Address Operating & Financing Risk
   - Structure the Supply Chain to meet Project needs
   - Performance Requirements for Supply Chain embedded in structure
   - Evaluate options beyond just Cost/Price impact – think about the impact on long-term success and risk

Developing a successful Biomass supply chain structure has the potential to make or break the financial outcomes of a project.

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- Thank You -

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kalthoff@equinox8.com
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