

MAYER • BROWN

# Advanced Biofuels – Ready for Primetime?

January 19, 2012

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# Speakers



*Moderator:*

**Paul Forrester**  
**Partner**  
**Mayer Brown**

# Speakers



*Panelist:*

**Mackinnon Lawrence**  
**Senior Analyst**  
**Pike Research**

# Speakers



*Panelist:*

**John May**  
**Managing Director**  
**Stern Brothers & Co.**

# Speakers



*Panelist:*

**Prabhakar Nair**  
**VP Business Development**  
**LanzaTech**

# Speakers



*Panelist:*

**Dirk Andreas**  
**SVP Business Development NA**  
**Enerkem**

# Speakers



**Q&A:**

**Ellen Wesley**  
**Principal**  
**CarbonConnect**



## **Global Biofuels Outlook**

Advanced Biofuels: Ready for Primetime?

January 2012

**Mackinnon Lawrence**  
Senior Analyst



- **Market research and consulting firm**
  - Focused on global cleantech markets
  - Offices: United States, Europe, and Asia
  - 5 practice areas
    - Smart Transportation
    - Smart Energy
    - Smart Grid
    - Smart Buildings
    - Smart Industry

- **Published**

- *Biofuels Markets and Technologies* (4Q 2011)
- *Algae-Based Biofuels* (4Q 2010)

- **Pipeline**

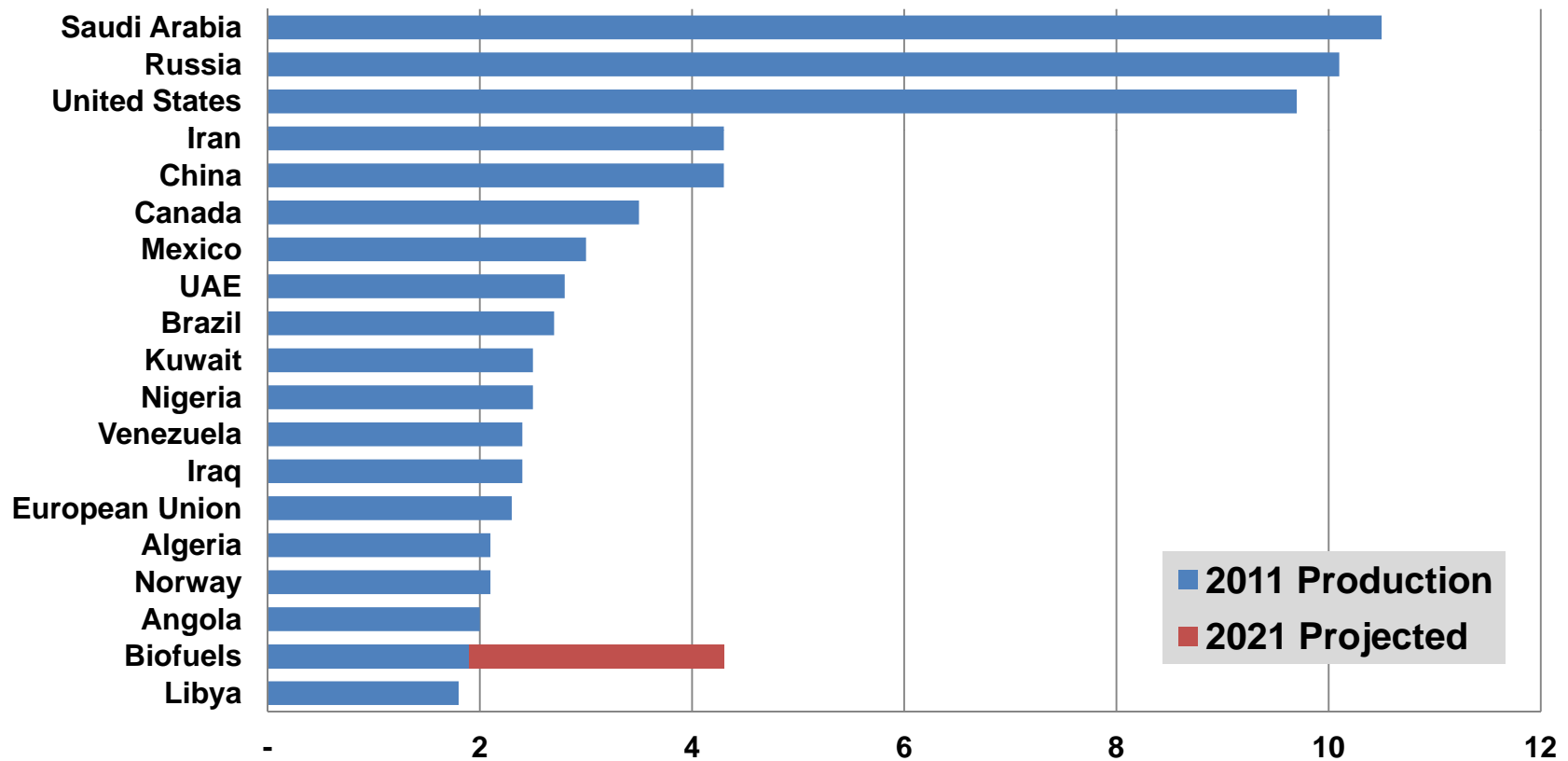
- *Biochemicals & Products*
- *Integrated Biorefineries* tracker

- **NEW: Bioenergy Advisory Service**

# 1) Not “if”, but “when”

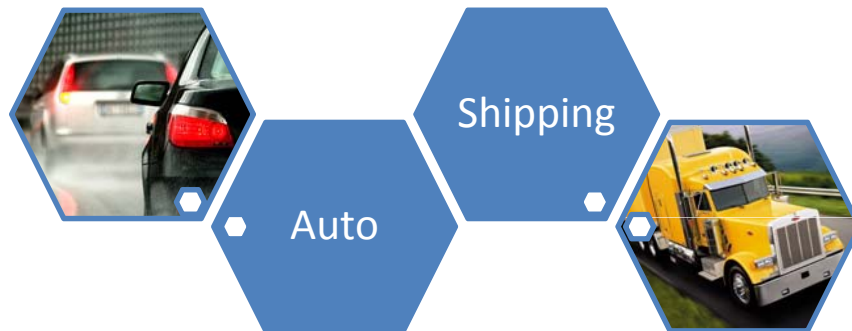
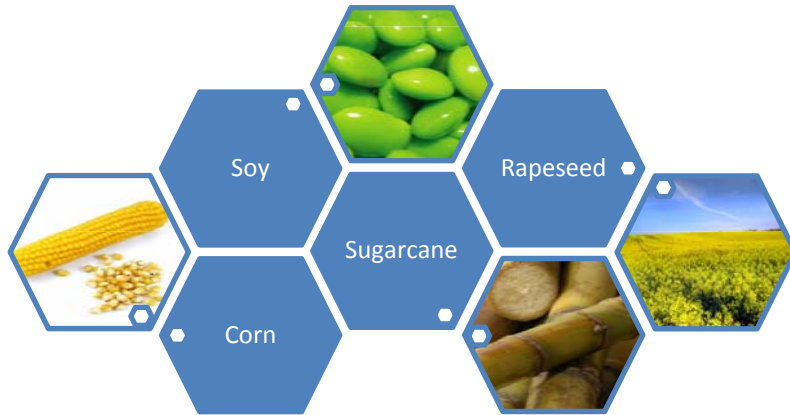
## \$3.2 trillion fuel market...

(Million bbl/day)

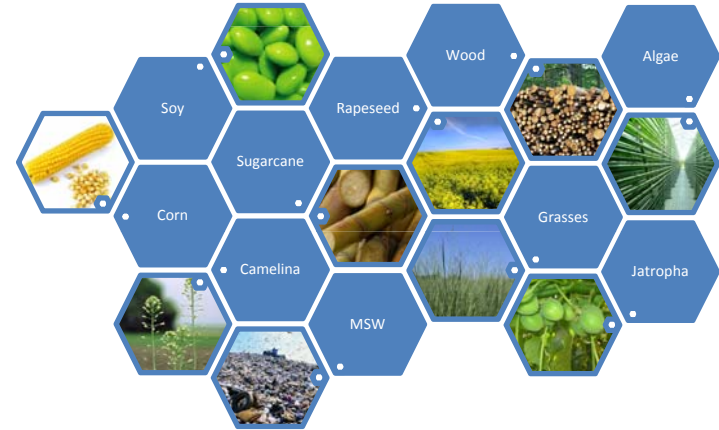


## 2) Supply Chain Complexity

2000s



2010s



### 3) Financing Challenges



- **U.S. estimates to meet RFS2 (from USDA)**
  - Additional 528 biorefineries (@ 40 MGPY)
  - \$168 billion in infrastructure investment needed
- **Pike Research global estimates (72 BGPY)**
  - Additional 1,056 biorefineries (@ 40 MGPY)
  - \$336 billion in infrastructure investment needed

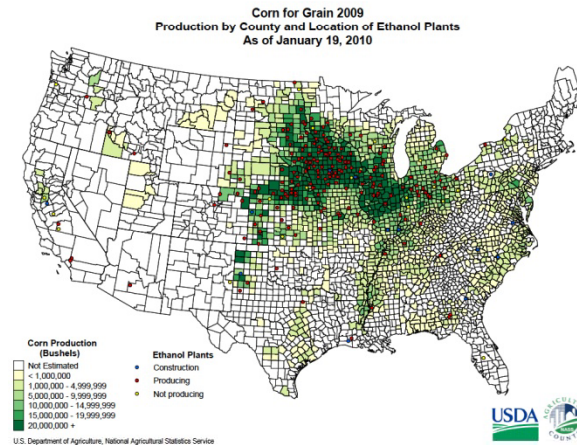
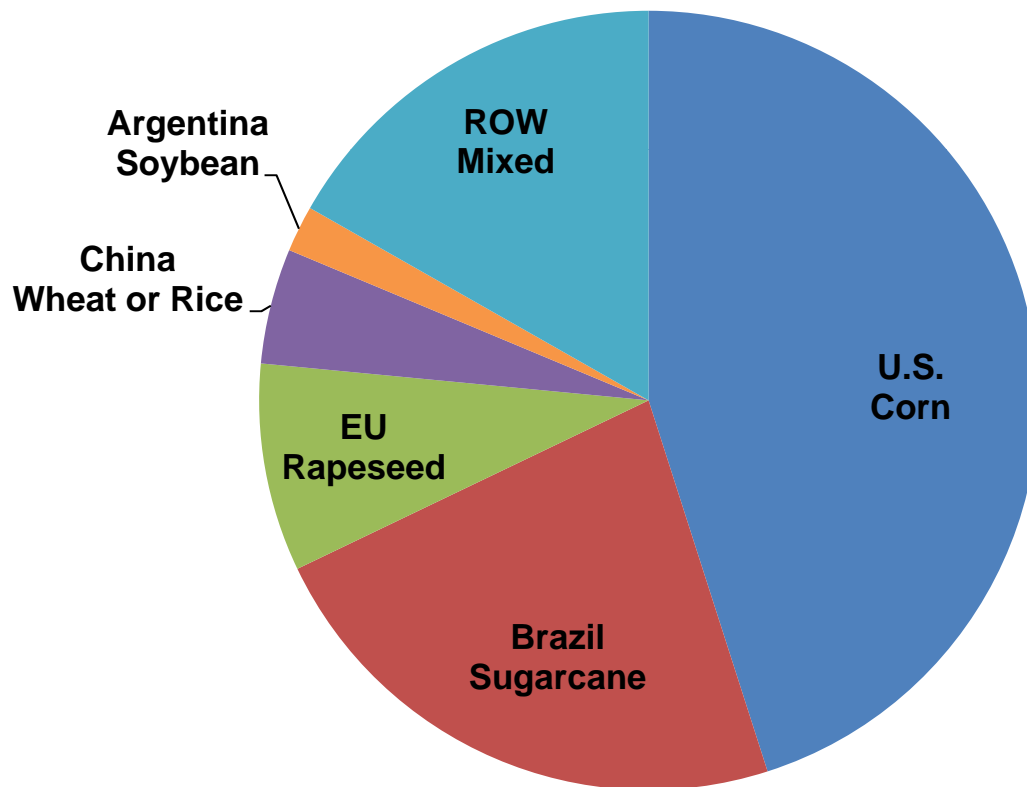
# Elephant in the Room

- **\$33.6 billion per year**



# Leading Biofuels Feedstocks

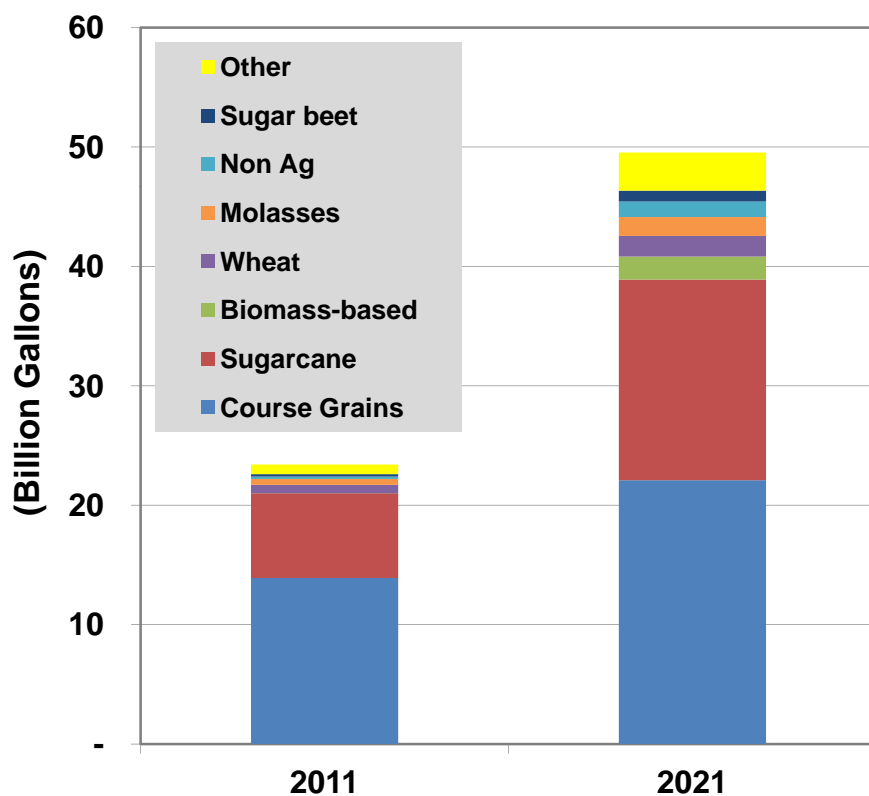
## Global Biofuels Market Share by Feedstock, World Markets: 2010



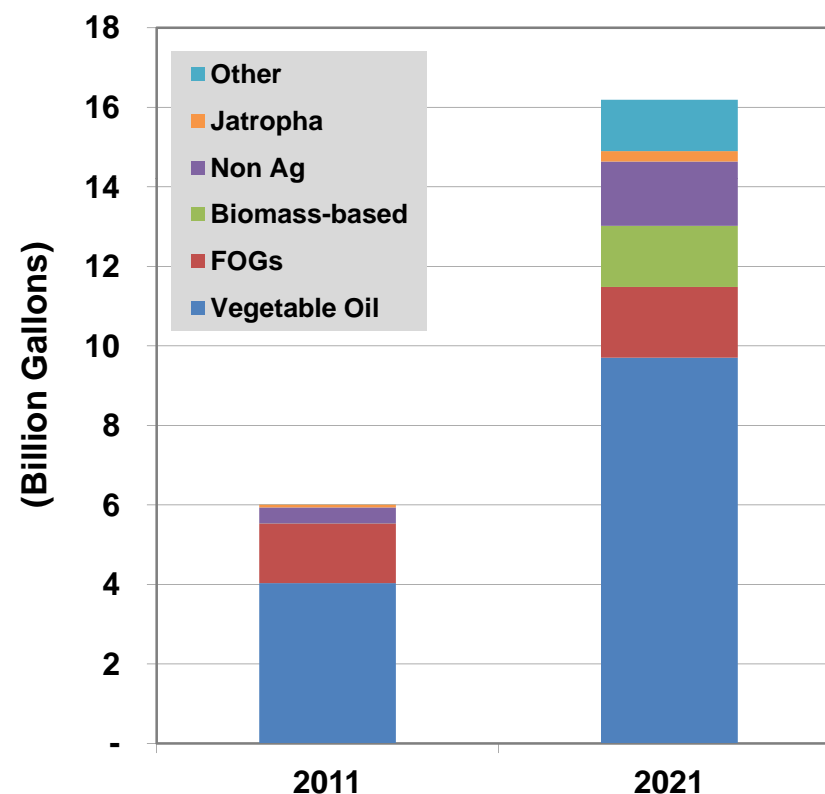
# Global Forecasts by Feedstock



## Biofuels Production by Feedstock, World Markets: 2011-2021



### Ethanol



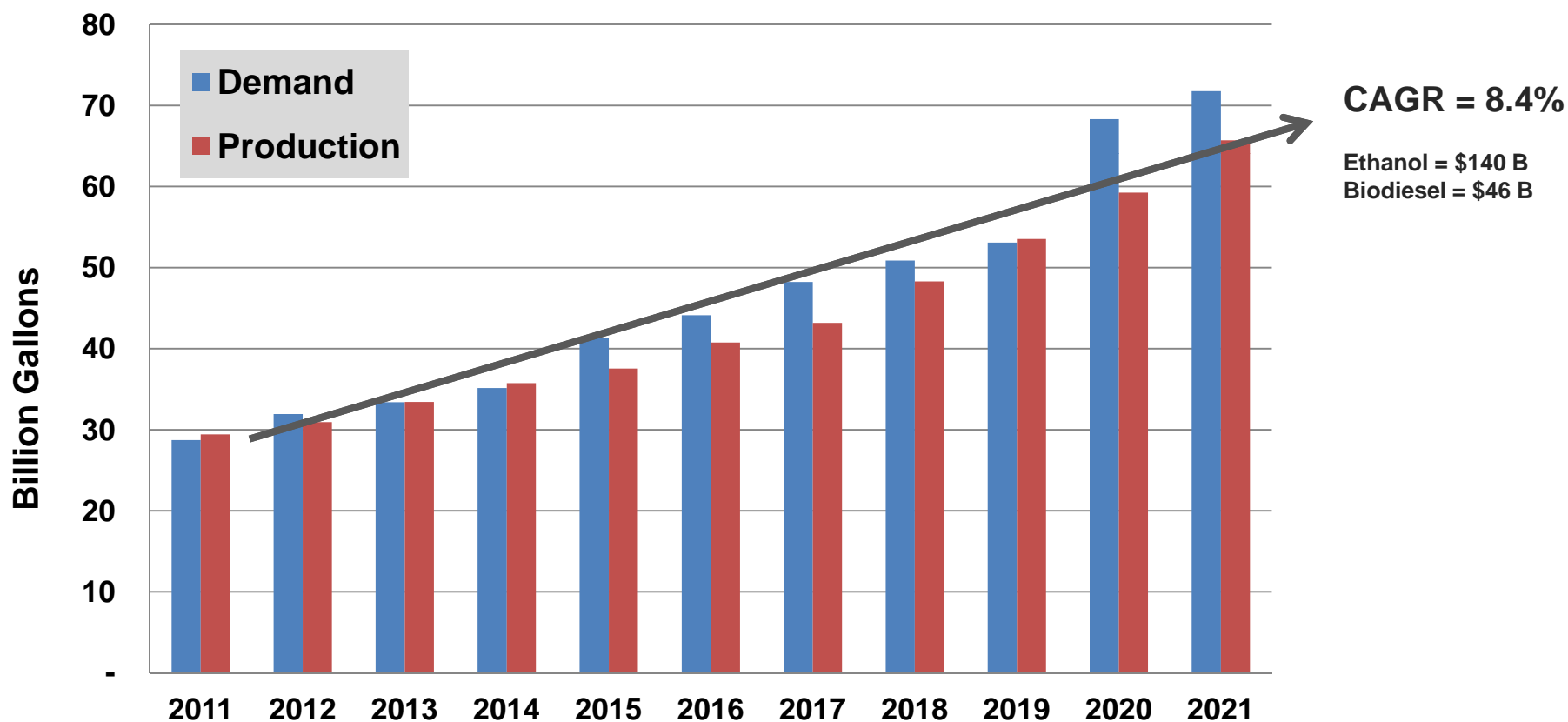
### Biodiesel



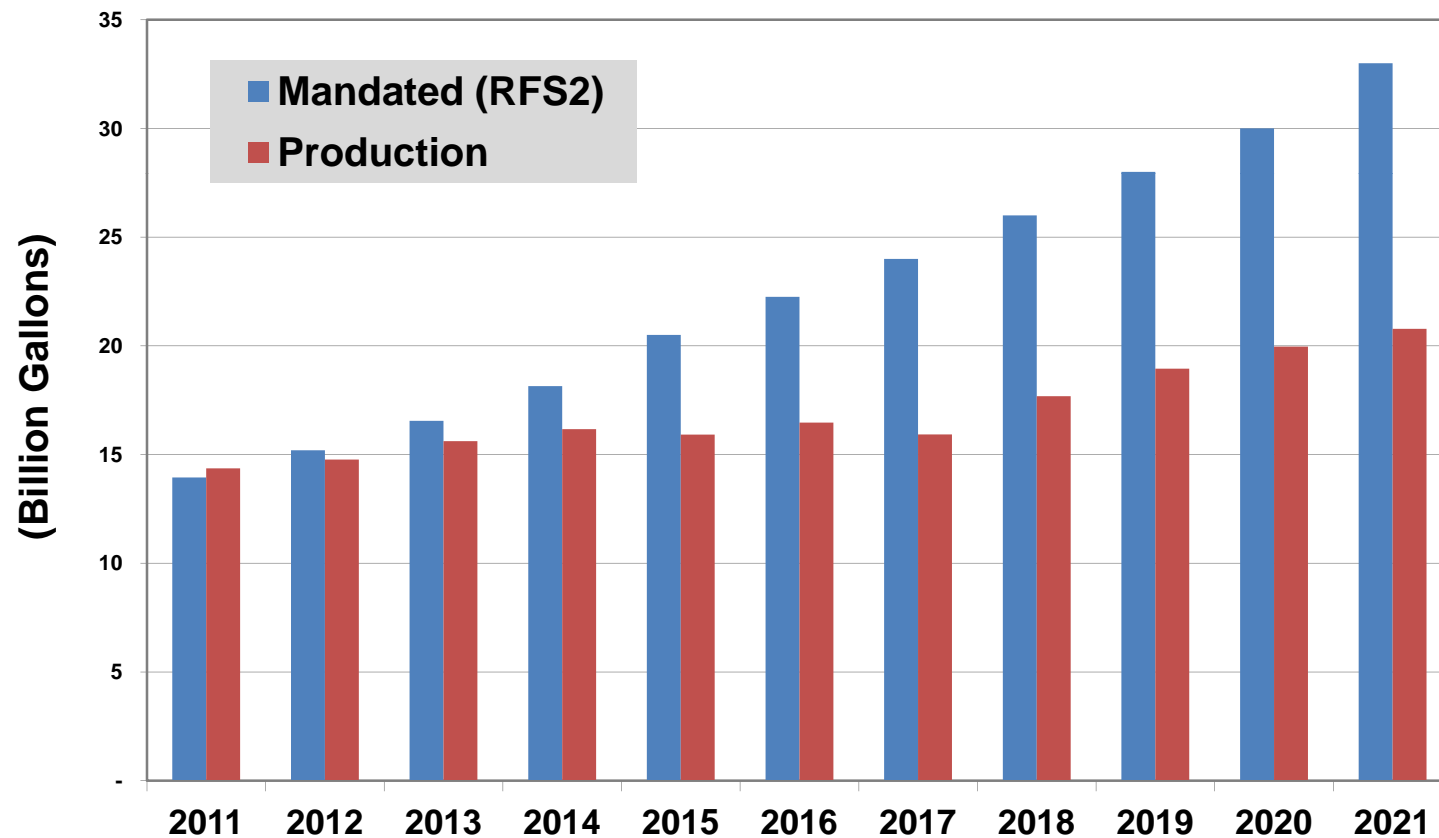
# Global Forecasts by Fuel



## Biofuels Demand & Production, World Markets: 2011-2021



## Biofuels Demand and Production, United States: 2011-2021



# Obstacle 1: Policy Diffusion

**Energy**

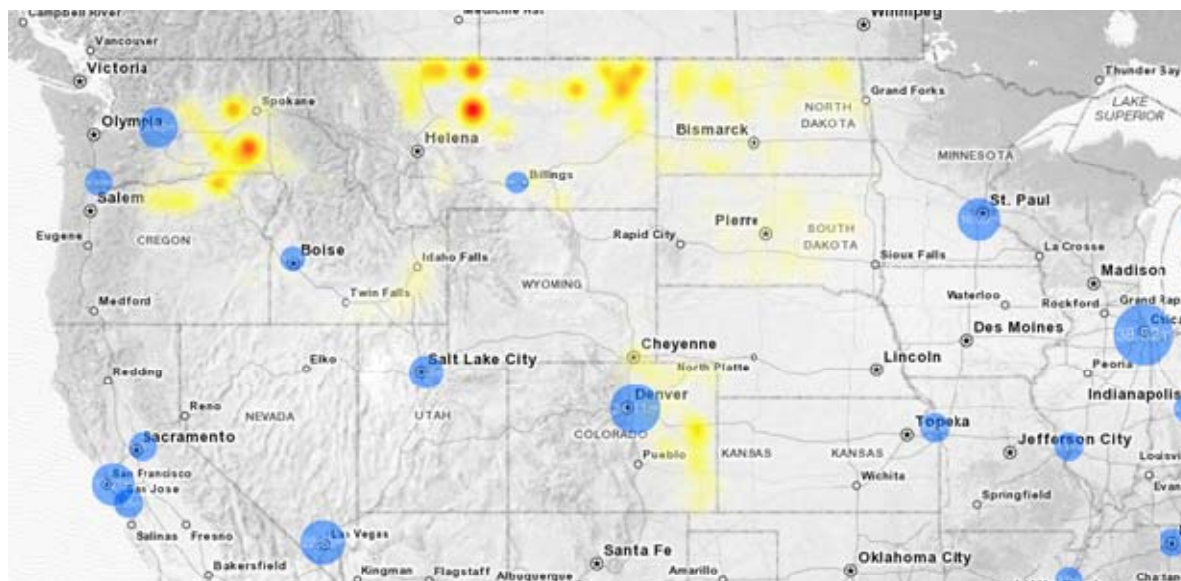


**Economic**

**Environmental**

## Obstacle 2: End Markets

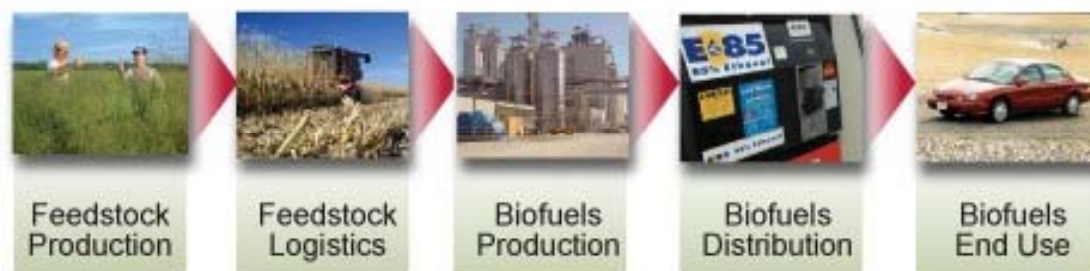
- **Aviation biofuels**
  - 20% US market = 4.3 BGPY (2021)
  - Concentrated demand centers



# Obstacle 3: Feedstock Supply

- **Feedstock supply chain challenges**

- Rise of feedstock hubs:
  - Midwest → United States
  - Brazil → World
  - SE Asia → China
  - Africa → EU



Source: DOE EERE

*The best time to plant a tree is 20 years ago.  
The second best time is now.*

- **What are we investing in?**
  - Near-term?
    - Offset crude oil dependency (good story for investors)
    - Mitigate climate change impacts
    - But, how do we quantify success? (e.g. ILUC)
  - Long-term?
    - Sustainable fuel infrastructure – for whom?

- 1. Focus shifting to near-term revenue**
- 2. IPOs continue; increased consolidation**
- 3. Aviation emerging as key growth driver**
- 4. Waste-to-Fuels near-term success story**
- 5. Rise of the Integrated Biorefinery model**

- from *Biofuels Markets & Technologies*

# Contact Us



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# **ADVANCED BIOFUELS: READY FOR PRIMETIME?**

**Chicago Clean Energy Alliance  
Chicago, Illinois  
January 19, 2012**

**John M. May  
Managing Director  
Head of the Alternative Energy Finance Group  
Stern Brothers & Co.  
St. Louis, MO**

# INTRODUCTION

- **Stern Brothers, founded in 1917 and headquartered in St. Louis, is an investment banking firm that is focused on project financing (taxable and tax-exempt) for renewable energy, real estate, higher education and healthcare.**
- **Stern's Alternative Energy Finance Group structures and places tax-exempt and taxable debt, and provides financial advisory services for renewable energy projects in the U.S.**
  - **Second generation biofuels, biochemicals, biomass, solar, wind, waste-to-energy, landfill gas-to-energy, cogen, CHP, hydro, geothermal**
- **Pipeline currently includes advanced biofuels, biochemicals, biomass, waste-to-energy, LFGTE, wind, solar, cogen / CHP.**

# IPO MARKET FOR BIOFUELS AND BIOCHEMICALS

- **Venture capital and private equity have been the source of capital for the research and development stages of many of biofuel and biochemical companies.**
- **As the industry has matured and the need for capital has increased, biofuel and biochemical companies have had to look for another source of capital.**
- **Over the last few years, some biofuel and biochemical companies have been able to turn to the IPO market as a means of raising capital to fund company growth.**
  - **Since 2009, six biofuel or biochemical companies have filed and priced IPOs**
  - **10 other companies have filed registration statements and are working towards an IPO**

## RECENT IPOs and IPO FILINGS

Priced	Filed	Company	Ticker	Product	Amount <sup>1</sup>
06-24-11	04-11-11	KiOR	KIOR	Biofuels	\$150,000,000
05-27-11	03-11-11	Solazyme	SZYM	Biofuels	\$197,550,000
04-20-11	11-08-10	Mission NewEnergy	MNEL	Biofuels	\$25,065,000
02-10-11	08-12-10	Gevo	GEVO	Biochemicals	\$107,250,000
09-28-10	04-16-10	Amyris	AMRS	Biofuels	\$84,800,000
04-22-10	12-28-09	Codexis	CDXS	Biofuels	\$78,000,000
Pending	11-14-11	BioAmber Inc.	BIOA	Biochemicals	NA
Pending	09-22-11	Fulcrum Bioenergy	FLCM	Biofuels	NA
Pending	09-21-11	Elevance Renewable Sciences	ERSI	Biochemicals	NA
Pending	09-16-11	Mascoma	MCM	Biofuels	NA
Pending	08-23-11	Genomatica	GENO	Biofuels	NA
Pending	07-18-11	Renewable Energy Group	REGI	Biofuels	NA
Pending	06-29-11	Luca Technologies	LUCA	Biofuels	NA
Pending	05-27-11	Myriant	MYRT	Biochemicals	NA
Pending	05-23-11	Ceres	CERE	Biofuels	NA
Pending	08-11-10	PetroAlgae	PALG	Biofuels	NA

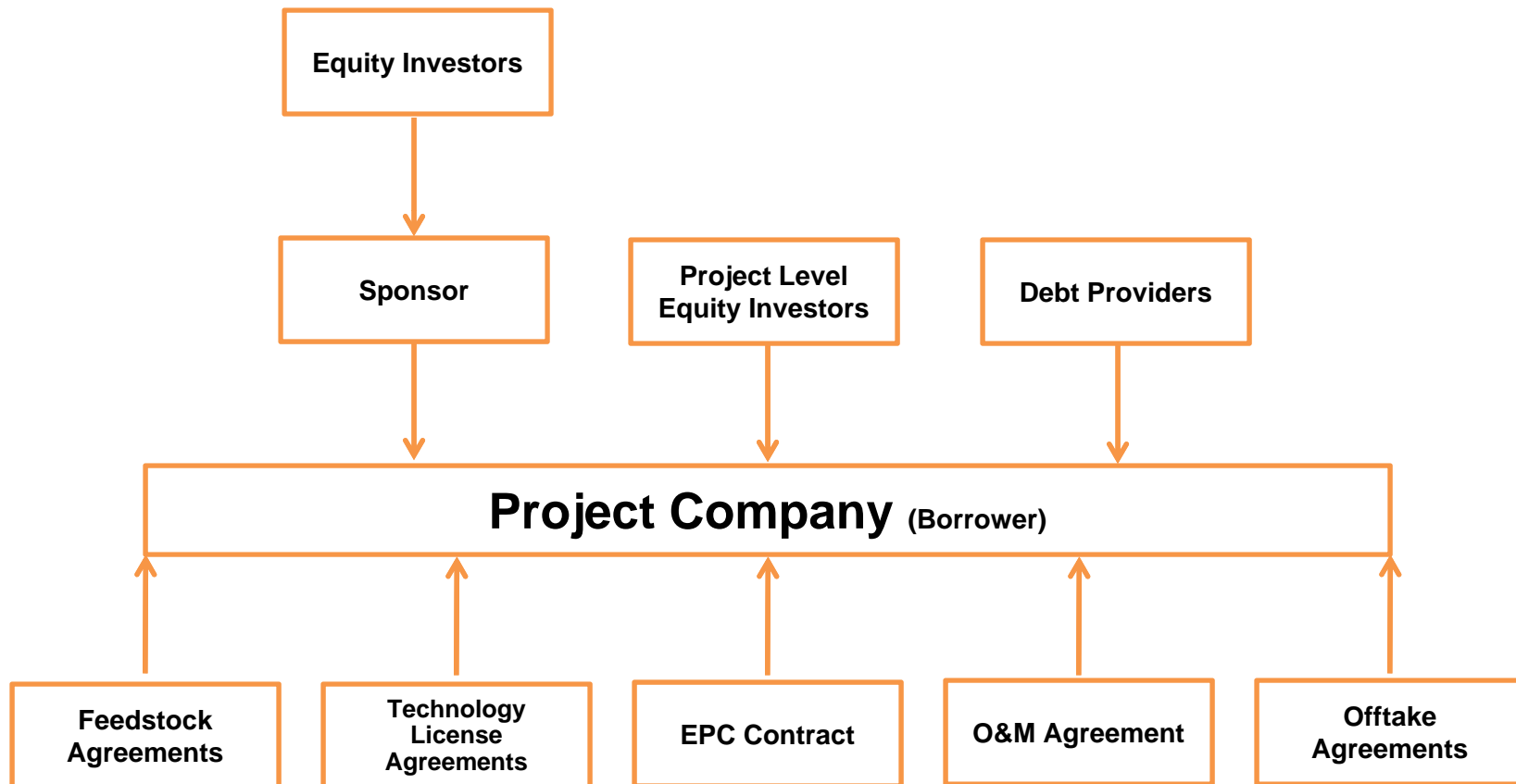
<sup>1</sup> Does not take into account the exercise of the overallotment option

## **ALTERNATE CAPITAL SOURCE: PROJECT FINANCE**

- **The IPO market has provided a source of capital for biofuel companies, however these companies are looking for alternate financing options that can maximize returns and not tie-up liquidity.**
- **Project finance can provide an alternate capital source for public or private companies looking for construction financing.**
  - **Debt provided for project development solely based on projects' perceived risks and expected future cash flows**
  - **Debt providers either have no recourse or only limited recourse to parent company that develops or “sponsors” project**
  - **For equity investors, equity returns maximized, significant liabilities moved off balance sheet, key assets protected and opportunities for tax financing monetization**

# ALTERNATE CAPITAL SOURCE: PROJECT FINANCE

## Typical Project Finance Schematic



# BONDS AND PROJECT FINANCE

- **Along with equity, traditional sources of capital for project finance include bank debt and tax equity.**
- **The much-discussed problems in the bank market and the smaller appetite of tax equity buyers have led renewable energy developers to seek new sources of capital for project finance.**
- **Stern Brothers pioneered the use of bonds to finance the development of renewable energy projects in 2003.**
- **Bonds can be sole source of debt or a complement to bank debt and offer structural advantages such as longer tenor, lower interest rate and flexible amortization that improve equity returns.**

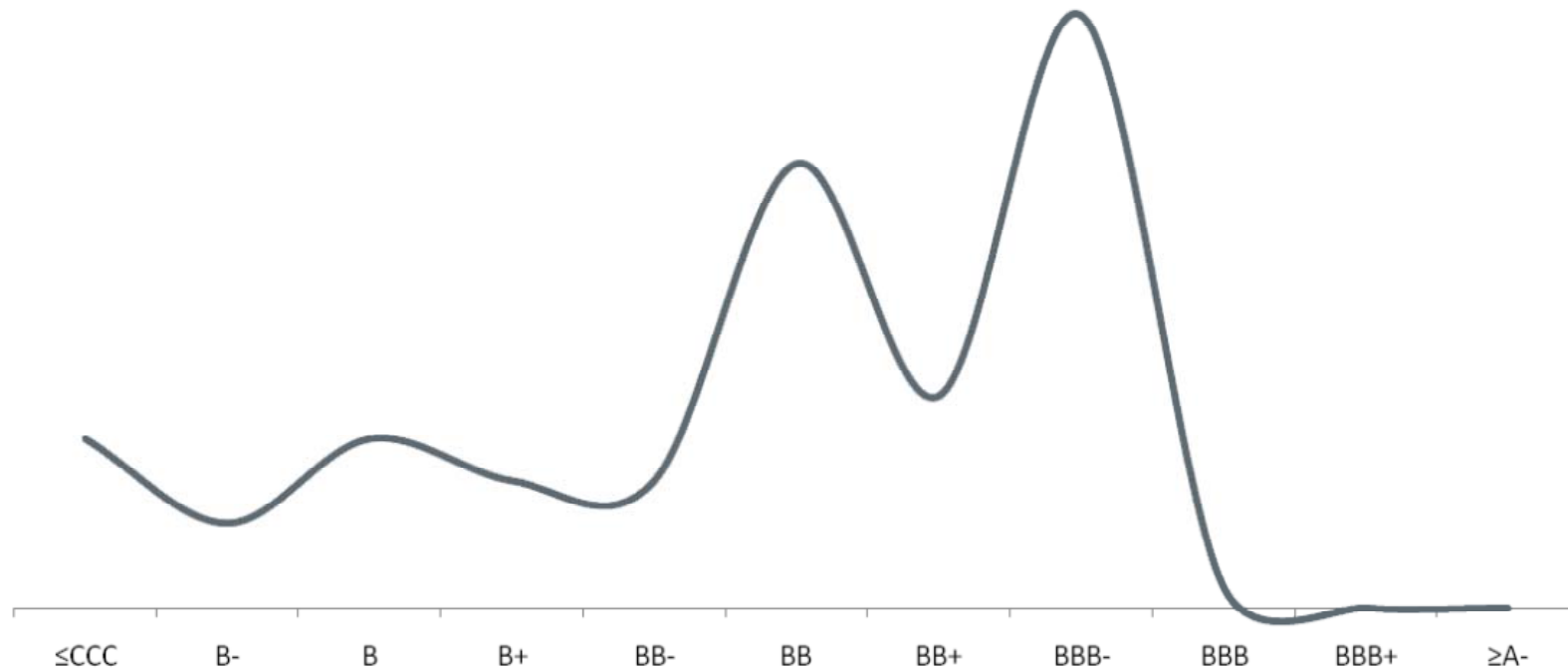
# BANK VS. BOND MARKET

Issue	Banks	Bonds
Large Transactions	Syndication Risk	Access to incremental pool of investor capital
Complex Transactions	Prefer “cookie cutter” deals	Good for “story” credits in emerging markets
Timing	Slow (9-12 months)	Fast (4-6 months)
Cost	Expensive	Cheaper
Technology Risk	Less likely to accept	Ability to mitigate some technology risk and accept residual
Construction Risk	Will assume with proper controls (IE)	Will assume with “bank like” controls
Capitalized Interest	None	Raised at financial close
Drawdowns	Timed to construction schedule	Disbursed at closing (negative carry in steep curve environment)
Tenor	Shorter (5-7 years)	Longer (15-20 years)
Interest Rate	Higher, Floating	Lower, Fixed Rate
Covenants	More restrictive	Less restrictive
Amortization	Usually straight line or mortgage style	Flexible—can be sculpted to match cash flow & meet ratios
Cash Sweeps	Customary	Not customary
Prepayments	Customary	Make whole provisions (call premium)



# AVERAGE PROJECT RATINGS

## Project Finance Renewable Portfolio Rating Distribution



Source: Fitch Renewable Energy Forum 6/23/11

Note: Includes Public, Private Ratings and Credit Assessments

# BOND CREDIT ENHANCEMENT MECHANISMS

- Currently, the average biofuels or biochemicals project reviewed by the rating agencies finds itself well below the investment grade threshold due to factors such as technology risk, construction or scale-up risk or feedstock risk.
- There are various credit enhancement mechanisms that can be employed to help mitigate these risks and allow the bonds to be priced at a more reasonable interest rate level.
- Third Party Insurance
  - Third party insurers with both the technical expertise and balance sheets bond investors consider investment grade have begun offering highly tailored technology warranties that may support a bond funded project financing

# BOND CREDIT ENHANCEMENT MECHANISMS

- **State and Local Government Credit Enhancement**
  - State and local governments have a history of supporting alternative energy projects
  - Support can range from accelerated permitting to substantial support in the form of guaranteeing the debt through a “Moral Obligation”
- **The United States Department of Agriculture**
  - The U.S. Department of Agriculture (USDA) has a portfolio of programs of which the most interesting to biofuel developers is the 9003 Biorefinery Assistance Program
  - The 9003 Biorefinery Assistance Program supports the commercialization of innovative biorefining technologies that produce fuels and other products
  - Companies that use waste as feedstock qualify for the program, which has a maximum loan amount of \$250 million
  - 9003 has a sliding scale for the percentage of the loan guaranteed, ranging from 90% to 60%

# BOND CREDIT ENHANCEMENT MECHANISMS

- **Export Finance Agency Loan Guarantees**
  - Most OECD member countries have an export finance agency whose goal is to support the export sales of goods and services from their country
  - The majority have project finance programs that can guarantee loans and many have a policy of supporting alternative energy and sustainability
  - The amount of the loan guarantee from an export finance agency is based on percentage of domestic content (either goods or services) to be exported to a foreign buyer
  - That loan guarantee becomes a 100% unconditional repayment obligation of the export finance agency whose credit rating is equivalent to its national government's credit rating
  - Export finance agency financing require goods and service to move across borders

# **NEW MARKET TAX CREDITS (NMTC) – ANOTHER SOURCE OF PROJECT CAPITAL**

- **Improves capital structure by introducing capital with de minimis claim on project cash flow**
- **NMTC capital subsidy equal to approximately 20% of the NMTC Allocation**
- **Challenges related to the principal repayment schedule and reduced rights and remedies associated with the NMTC Leveraged Loan structure:**
  - **Leveraged Loan is interest only for 7 years**
  - **Leveraged Lender receives an indirect security interest in the physical assets of project**
  - **Leveraged Lender agrees to forebear during 7 year compliance period to avoid recapture of tax credits**
  - **Proceeds from project level loan foreclosure would likely be reinvested in a new qualified project and not returned to the Leveraged Lender during first 6 years of Leveraged Loan**

## **NEW MARKET TAX CREDITS (NMTC) – ANOTHER SOURCE OF PROJECT CAPITAL**

- **Leveraged Lenders require a higher interest rate to compensate for the increased risk from delayed principal repayment and their reduced rights and remedies during the 7 year NMTC compliance period, often eroding the benefits of the NMTC capital subsidy.**
- **Stern Brothers advocates investing Sponsor Equity as “Leveraged Loan” into NMTC structure to avoid issues associated with third party debt while still generating low-cost non-dilutive capital.**

**John M. May**  
**Managing Director**  
**Head of Alternative Energy Finance Group**  
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**St. Louis, MO 63105**

# Carbon Capture and Reuse: *New Approaches for Producing Biofuels*

*P. Nair  
LanzaTech US*



Clean Air Alliance Conference  
Chicago, January 19, 2012

**LanzaTech** 



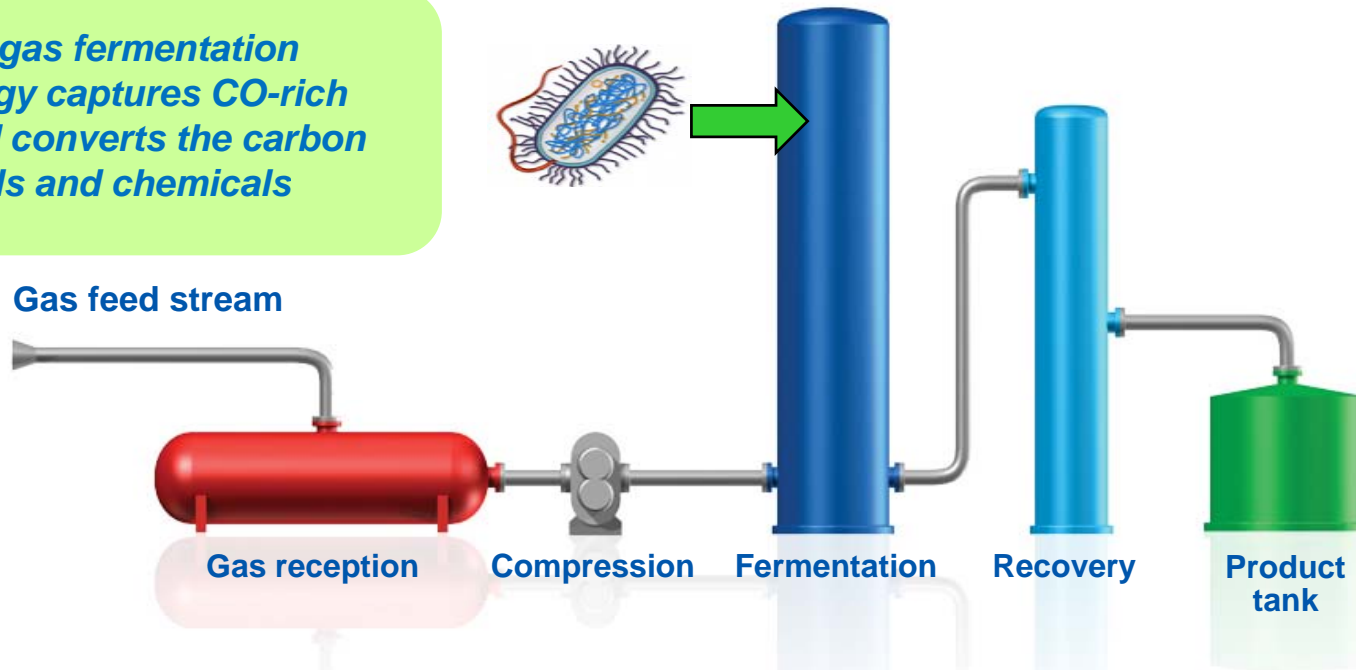
# Company Profile

- **Founded in January 2005**
- **Funding**
  - Series A: Khosla Ventures - \$US 12M in 2007
  - Series B: Qiming Ventures - \$US 18M in 2010
  - Series C: Burrill MLSF - \$US 56M in 2011
- **Team**
  - CSO/Founder: Dr. Sean Simpson***
    - 80 staff
      - Synthetic Biology
      - Analytical
      - Engineering
    - Auckland (New Zealand), Chicago (USA) and Shanghai (China)
- **IP Portfolio**
  - >100 patents filed
  - 2 proprietary microbe families



# The LanzaTech Process

*Novel gas fermentation technology captures CO-rich gases and converts the carbon to fuels and chemicals*



- Gases are sole source of energy
- Production of fuels and chemicals
- Potential to make material impact on the future energy pool (>100s of billions of gallons per year)
- Completely outside of the food value chain
- Biofuel, carbon capture and energy efficiency technology solution



1.4 billion  
tons steel/yr Globally

## Ethanol Potential From LanzaTech Process

30 billion gal/yr



1.3 billion  
tons/yr potential in US

190 billion gal/yr

- Access to opportunity and on purpose derived gas streams
- Potential to make significant impact on the fuel pool
- No impact on food production



# LanzaTech Gas to Liquid Platform



Resources

CO

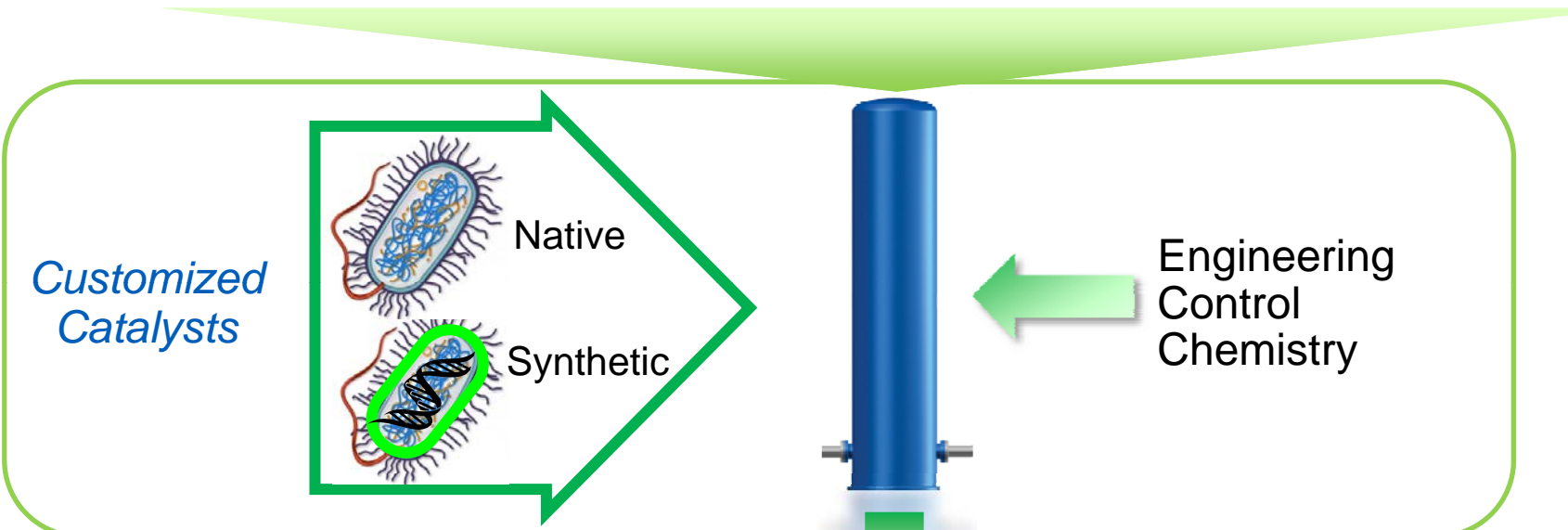
CO

H<sub>2</sub>

H<sub>2</sub>

CO<sub>2</sub>

CO<sub>2</sub>



Product Suite

**C<sub>2</sub>**

- Ethanol
- Acetic acid

**C<sub>3</sub>**

- *i*-propanol
- acetone

**C<sub>4</sub>**

- BDO
- *n*-Butanol
- *i*-Butanol
- Succinic acid

**C<sub>5</sub>**

- Isoprene

**Other**

- PHB
- .....

Product Suite

Hydrocarbon Fuels  
(diesel, jet,  
gasoline)

Chemical  
Intermediates

Olefins

Chemicals

*Thermochemical Approaches*

# A Fast Path to Commercialization

## *Pilot*



2008

- 15,000 gallons ethanol per year
- BlueScope steel mill, NZ
- Operating since 2008

## *Demonstration*



4Q2011

- 100,000 gallons ethanol per year
- Baosteel

## *Commercial*

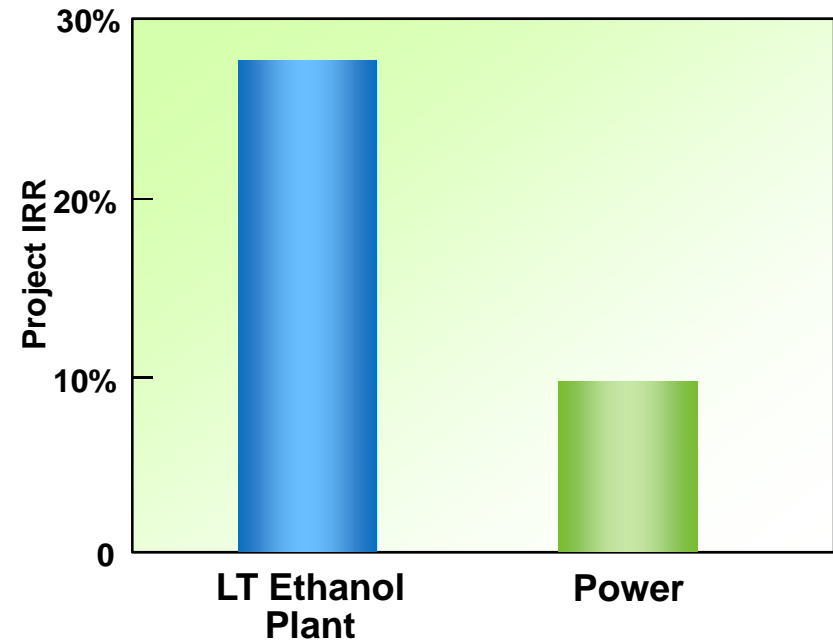
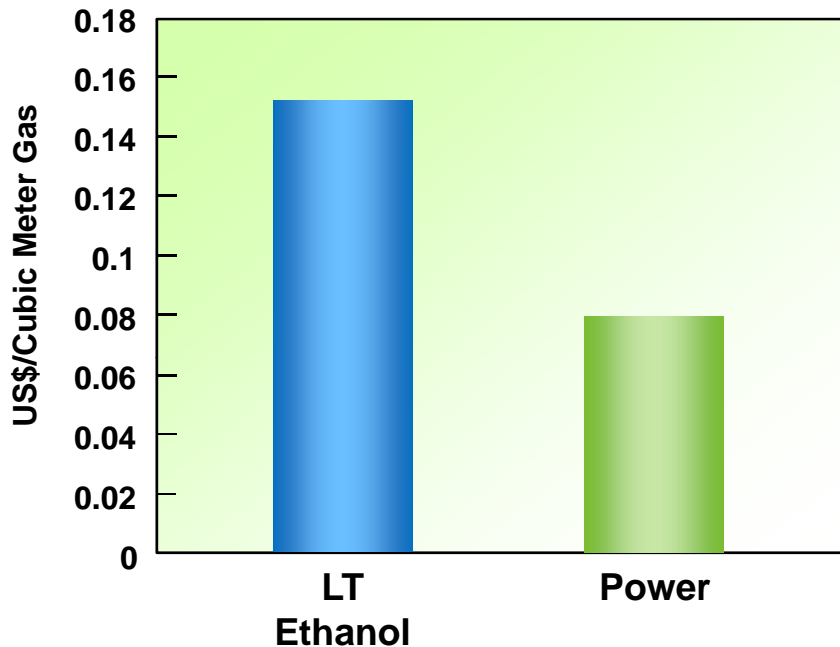


2013

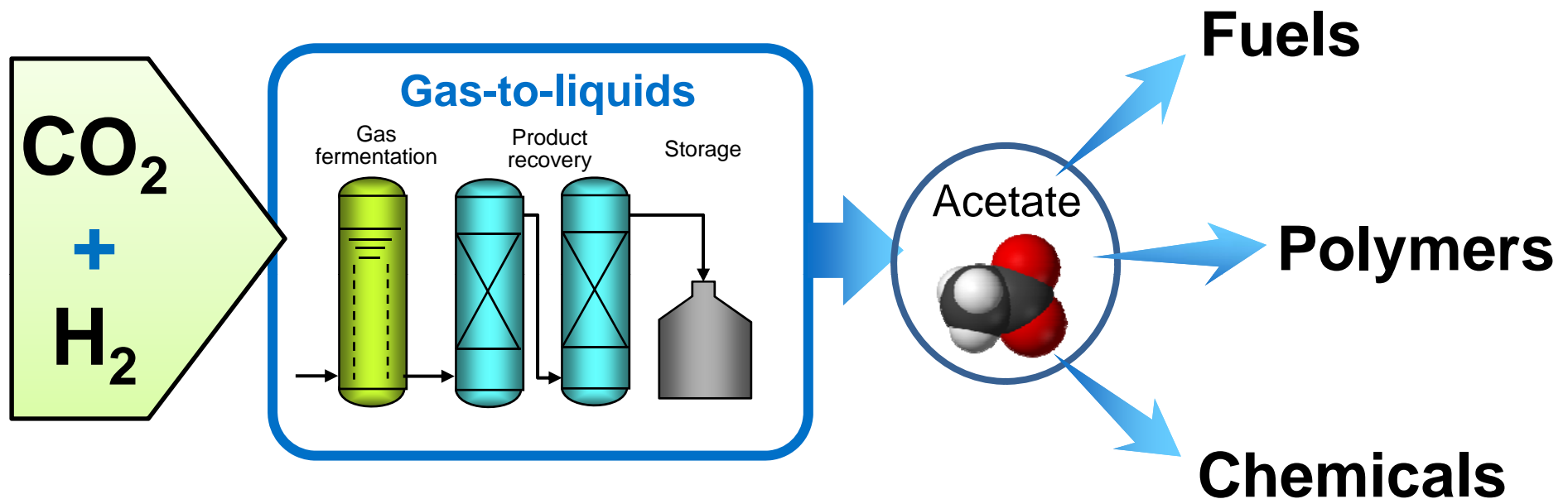
- >30 million gallons per year
- Baosteel

***Commercial Production by 2013***

# Steel Mill Value Proposition



- **BOF Gas from steel mill**
- **Key assumptions**
  - Ethanol Plant: 33 million gal/yr Capacity
  - Power: 53 MW Combined co-gen Gas turbine @ 42% efficiency
  - Electricity at \$0.085/kWhr; Ethanol at \$2.50/gallon



## *CO<sub>2</sub> uptake and capture demonstrated in a continuous fermentation*

- CO<sub>2</sub> is the carbon source, H<sub>2</sub> is the energy source for product synthesis
- Developed for waste coking gas applications
- Productivity of 90g/l/day demonstrated at lab scale

# Rapid Deployment



Minimal competition for industrial waste gases - only alternatives are cogen or heating

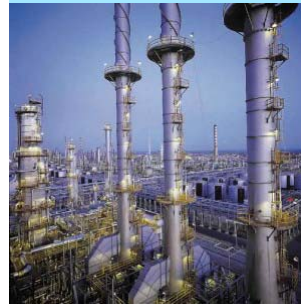


Multiple plants per partner

Steel



Refining



IndianOil

Chemicals



Coal

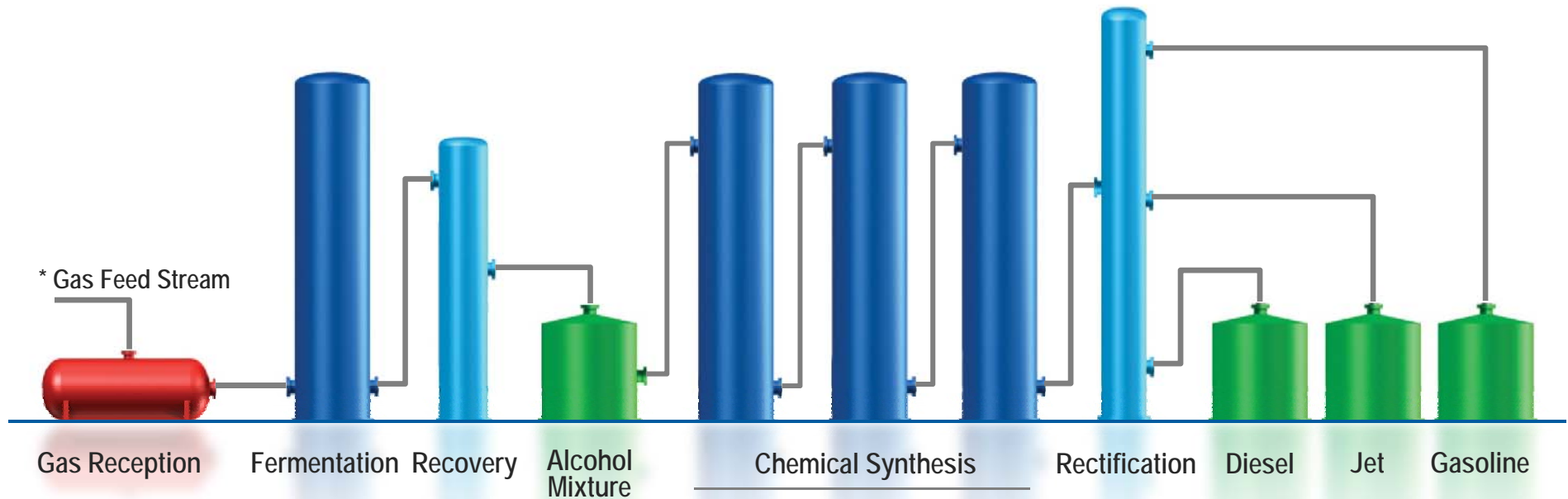


Waste Biomass



*Potential >350 M gal/yr from existing agreements/MoUs* 48





## *Gas Feed Stream*

- CO from Industrial Waste Gases
- Syngas from Biomass, MSW, Reformed Natural Gas or Other Sources

***Novel Route to Drop in Hydrocarbon Fuels  
Key Enabler: Price and Availability of Alcohol***

# Commercialization of Aviation Fuel



Swedish BioFuels



Imperial College of London



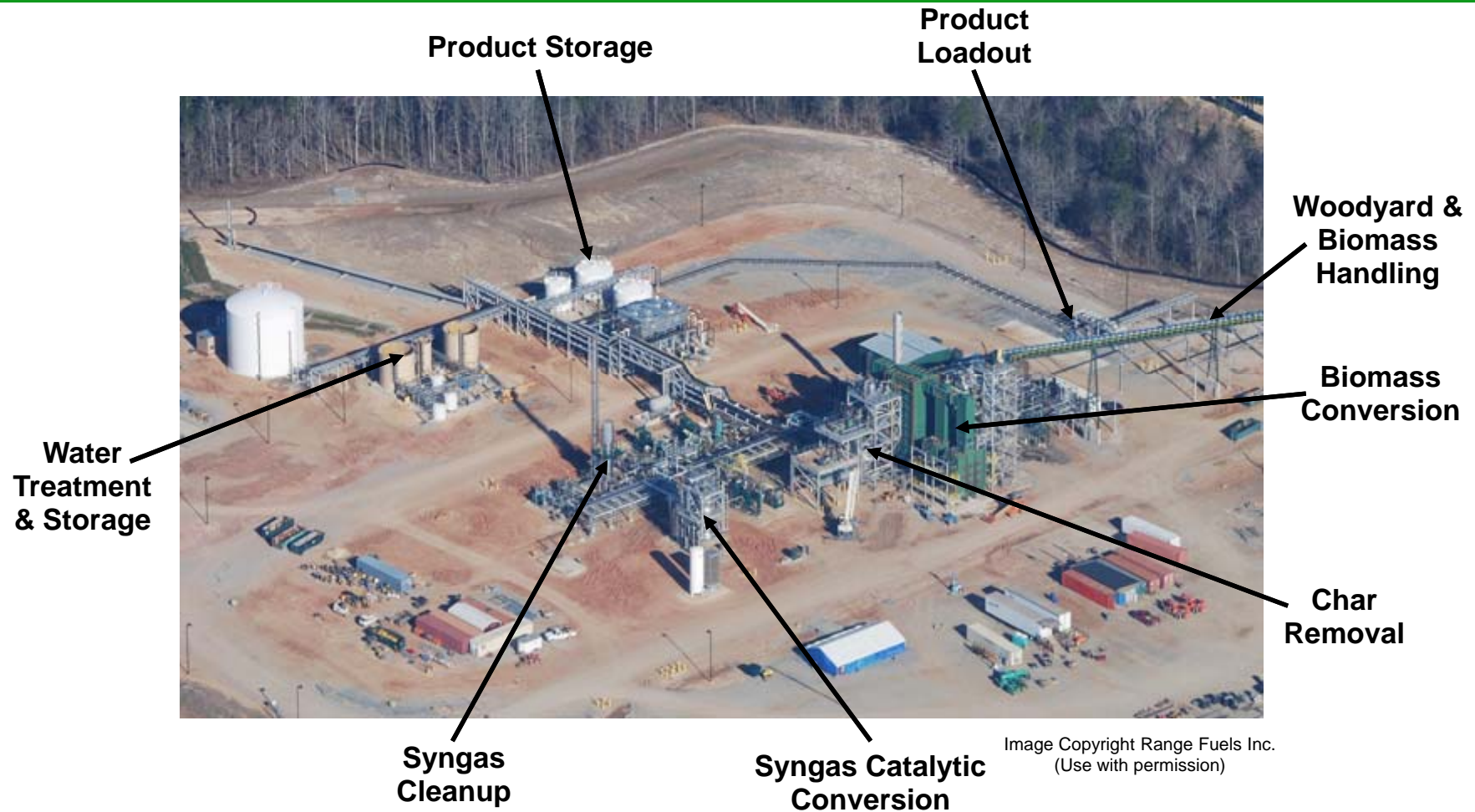
**RSB**  
ROUNDTABLE ON SUSTAINABLE BIOFUELS



***Team Work is Key to Success***



# Aerial View of LanzaTech Freedom Pines



***125 tpd Infrastructure in Place***

# A Sensible Path...

## Waste for Energy

Aligns:



Allows:



- LanzaTech is on a strong commercialization trajectory
- LanzaTech is creating a technology platform which could have a material impact on the future of energy, chemicals, carbon and waste
- LanzaTech is creating the partnerships required to create commercial success
  - Technology
  - Business

*Positioned to Lead*

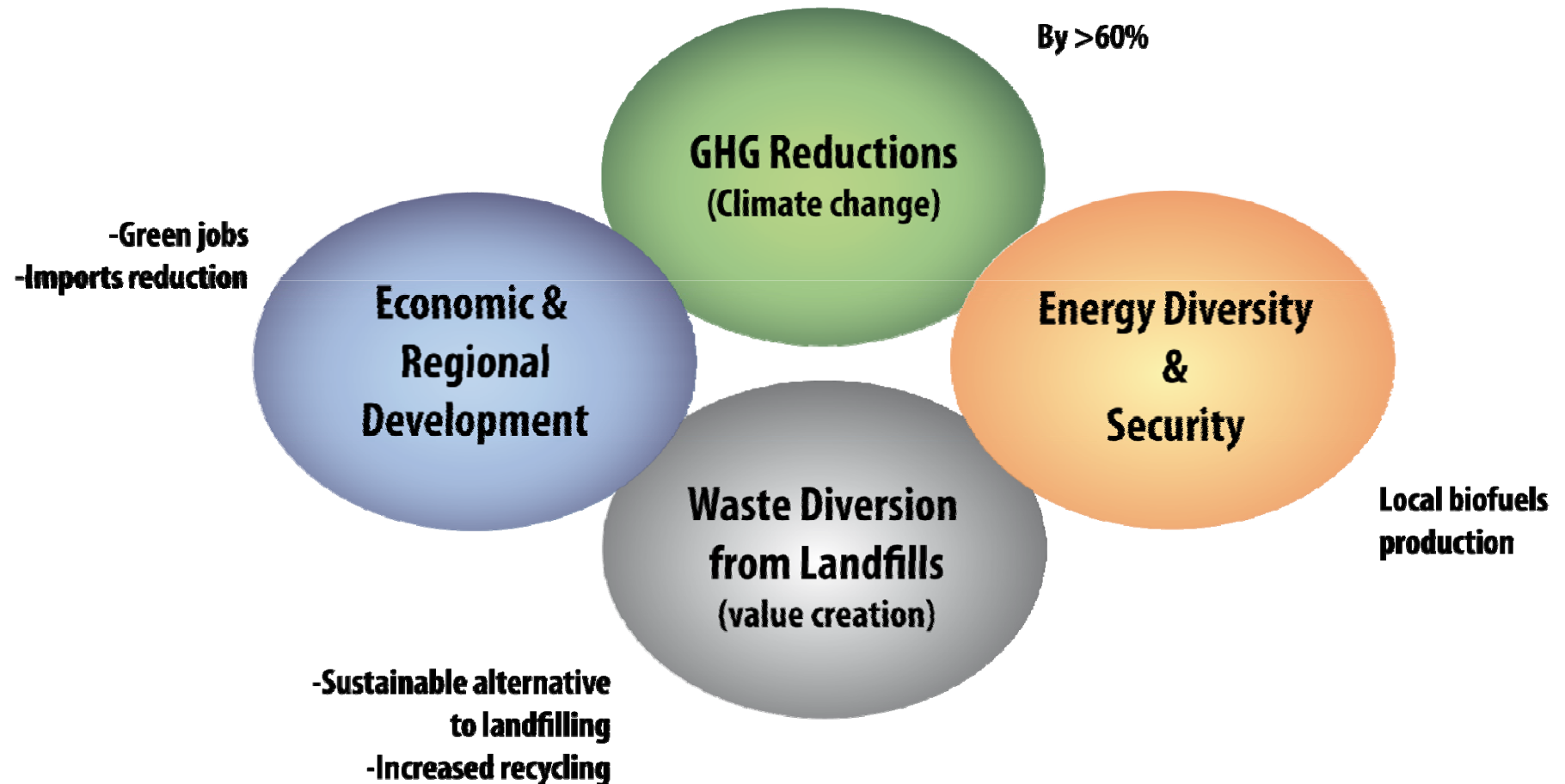


## CREATING VALUE FROM WASTE

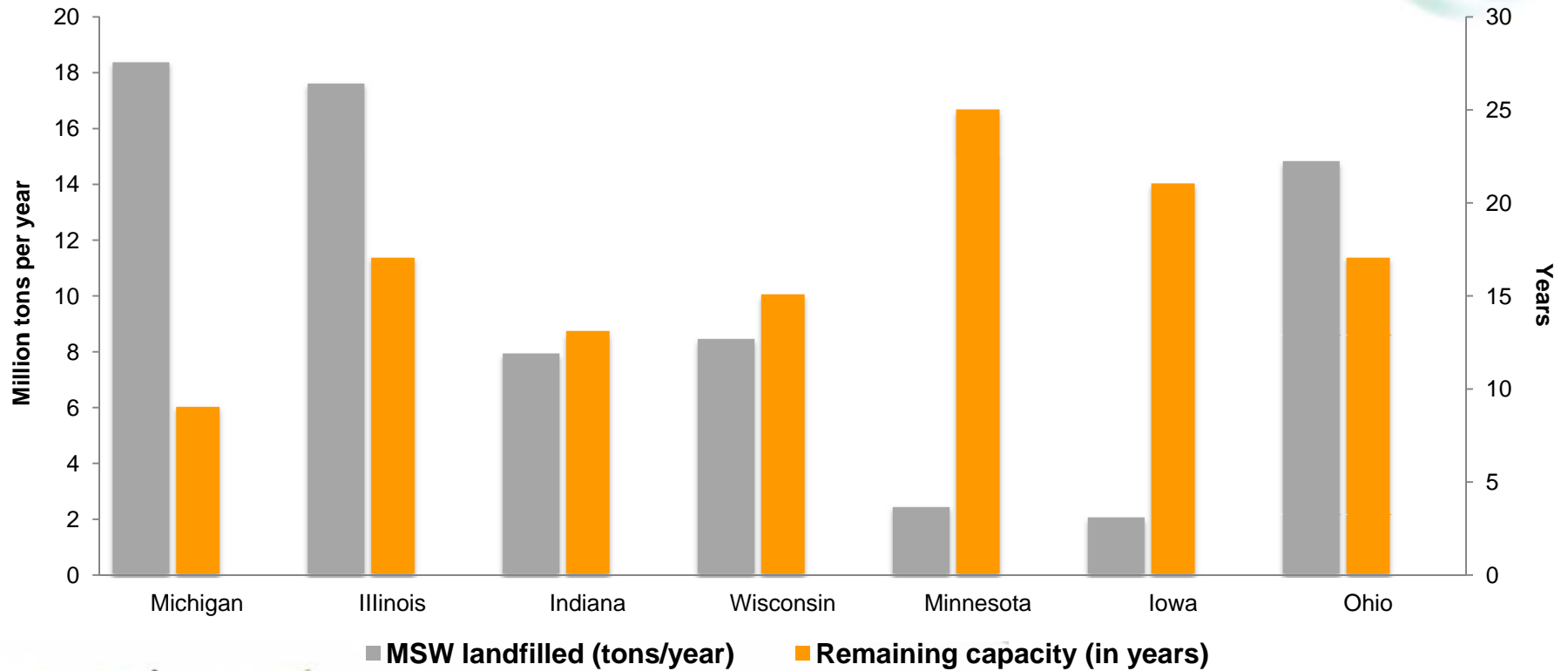
*Chicago Clean Energy Alliance –  
“Advanced Biofuels: Ready for Primetime?”*

*Dirk E. Andreas, SVP, Business Development - January 2012*

# Answering today's main challenges with *Advanced Biofuels*



# Solving a mounting challenge



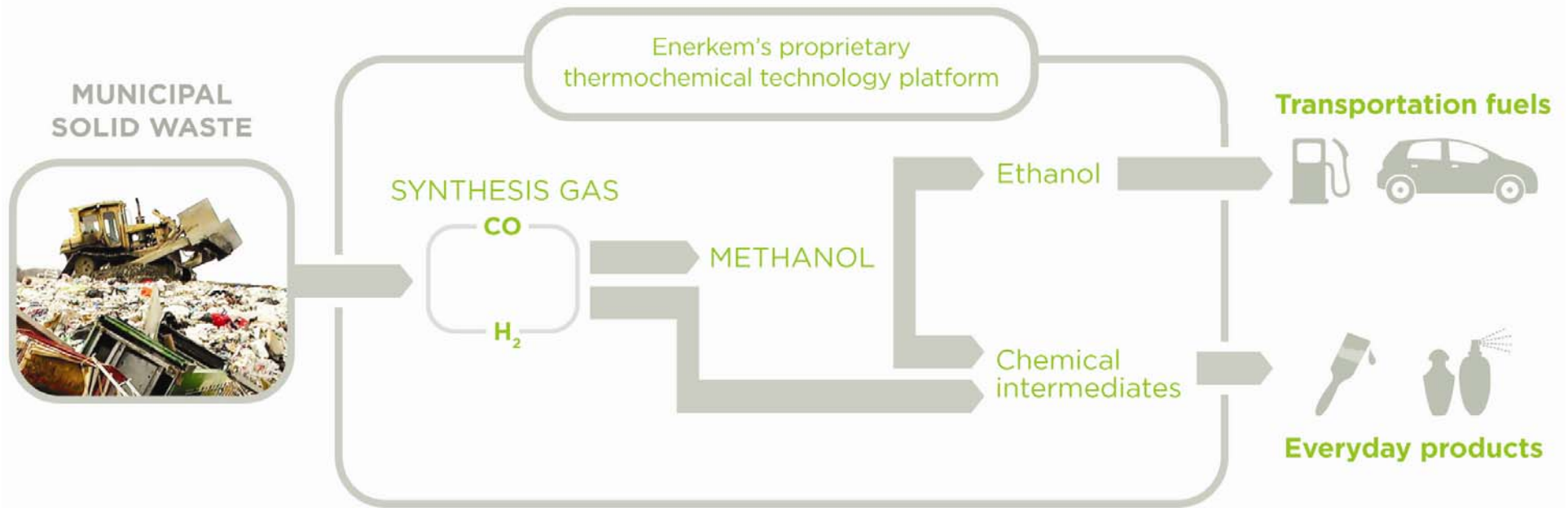
**Total MSW landfilled in U.S = 318 M tons (289 M metric tons)**  
**Remaining landfill capacity in U.S. = approx. 19 years**

Source: 2009, Waste Business Journal 2011



# Creating value from waste

*Proprietary clean technology*



- Developed in-house over 10 years
- Chemically-recycles carbon molecules found in waste
- Uses relatively low temperatures and pressures

- Has minimal air emissions. Meets regulatory environmental standards
- Primarily focusing on commercial production of cellulosic ethanol from MSW

# Enerkem's key partners

## Government Support



## Strategic Investors/Partnerships



## VC & Institutional Financial Support



**Quince Associates, L.P.**

# Enerkem's locations

2 operating and 1 full-scale under construction



1

Sherbrooke, Quebec, Canada – Pilot Plant

2

Westbury, Quebec, Canada



- ✓ **Type:** Commercial Demo
- ✓ **Status:** Operating since 2009
- ✓ **Feedstock:** Treated wood
- ✓ **Capacity:** 1.3 MGPY (5 M litres/year)

3

Edmonton, Alberta, Canada



- ✓ **Type:** Commercial
- ✓ **Status:** Under construction
- ✓ **Feedstock:** Post-sorted MSW
- ✓ **Capacity:** 10 MGPY (36 M litres/year)

4

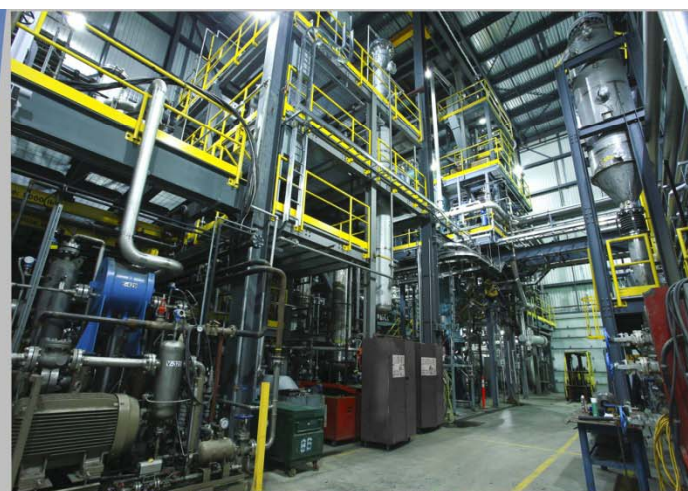
Pontotoc, Mississippi, U.S.A.



- ✓ **Type:** Commercial
- ✓ **Status:** Under development
- ✓ **Feedstock:** Post-sorted MSW
- ✓ **Capacity:** 10 MGPY (36 M litres/year)

★ **Headquarters:** Montreal, Quebec

# Operating commercial demonstration facility *Westbury, Quebec*



# Full-scale commercial facility

## Edmonton, Alberta



<b>Type:</b>	Commercial
<b>Owner/ Operator:</b>	Enerkem (Enerkem Alberta Biofuels LP)
<b>Status:</b>	Construction expected to be completed for end of 2012
<b>Location:</b>	Edmonton, Alberta, Canada
<b>Capacity:</b>	<b>Input:</b> 350 metric tons per day  <b>Output:</b> 10 million gallons / 36 million litres per year
<b>Feedstock:</b>	25-year agreement with the City of Edmonton for 100,000 metric tons of sorted municipal solid waste per year
<b>Products:</b>	Methanol, followed by cellulosic ethanol



Facility Groundbreaking Event

Expected to increase  
Edmonton's municipal waste  
diversion rate to **90%**

# Commercial facility under construction

*Edmonton, Alberta*



**August 2011**

# Full-scale commercial facility

## *Pontotoc, Mississippi*



<b>Type:</b>	Commercial
<b>Owner/ Operator:</b>	Enerkem (Enerkem Mississippi Biofuels LLC)
<b>Status:</b>	Under development
<b>Location:</b>	Pontotoc, Mississippi, USA
<b>Capacity:</b>	<b>Input:</b> 350 metric tons per day  <b>Output:</b> 10 million gallons / 36 million litres per year
<b>Feedstock:</b>	Mix of feedstocks comprising municipal solid waste (and wood residues)
<b>Products:</b>	Cellulosic Ethanol



3D representation of the future plant

Selected to receive  
funding from  
U.S. DOE and USDA

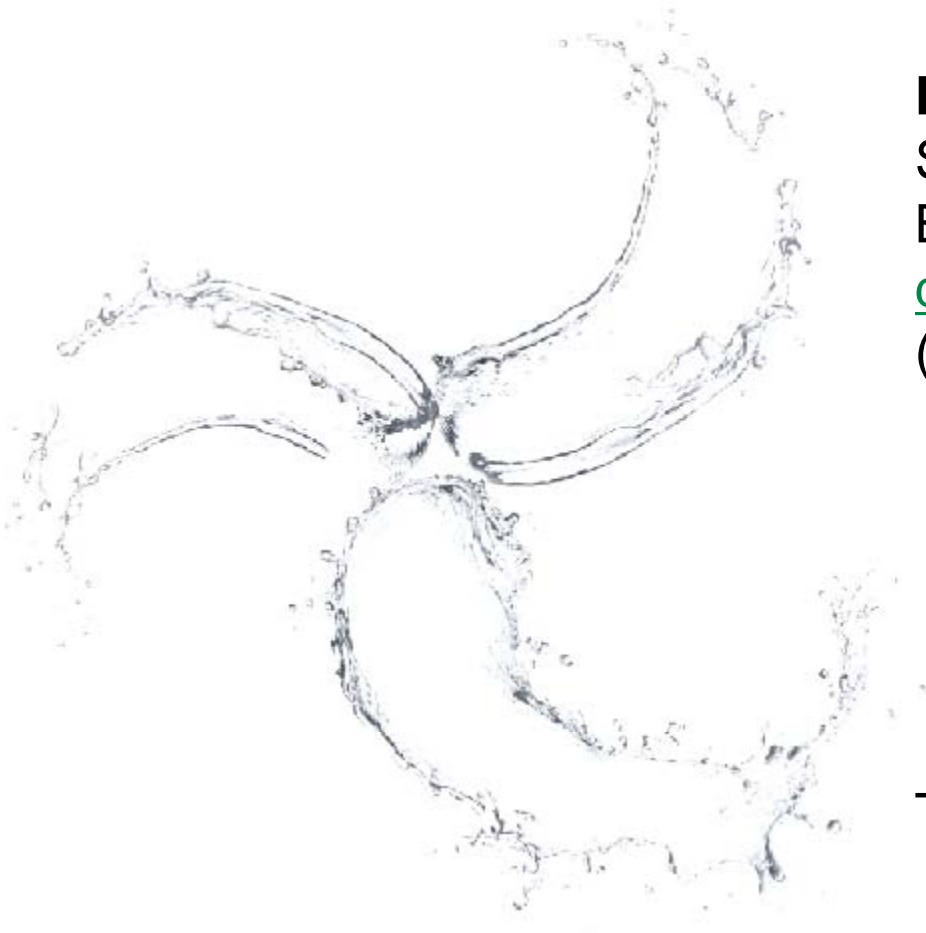
# Summary of Enerkem's model

## *Key success factors*



- **Cost-effective plant model**
  - ✓ Flexible technology
  - ✓ Modular and scalable design
- **Create significant economic benefits**
  - ✓ Create employment opportunities
  - ✓ Local and regional economic development
- **Provide a sustainable waste solution**
  - ✓ Lower need for new landfills
  - ✓ Diminish landfill methane gas emissions
- **Displace reliance on oil and petroleum**
  - ✓ Secure source of domestic renewable fuel
- **Use sustainable feedstock**
  - ✓ Non-food feedstock and no land use impact





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