



Washington Sustainable Aviation Fuels Summit: The Business Side of Feedstocks

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Managing Director
Ocean Park

The Primary Feedstocks and Technologies for RJF and RD

Since 2009, ASTM has approved 5 RJF production technologies.

Technology (Yr Approved)	Feedstock(s)	Project Developers / Technology Providers	Max Blend % with Jet A
FT-SPK (2009)	Coal, natural gas, woody biomass / forest residue, MSW	Fulcrum (BP, Johnson Matthey, Emerging Fuel Technology), Red Rock Biofuels (Velocys), Sasol, Shell	50%
HEFA (2011)	Fats, oils and greases	Neste, REG, World Energy (AltAir), Honeywell-UOP	50%
SIP (2014)	Sugar	Amyris, Total	10%
FT-SKA (2015)	Coal, natural gas	Sasol	50%
ATJ-SPK (2016)	Starch, sugar, cellulosic biomass	Gevo, LanzaTech	50% ⁽¹⁾

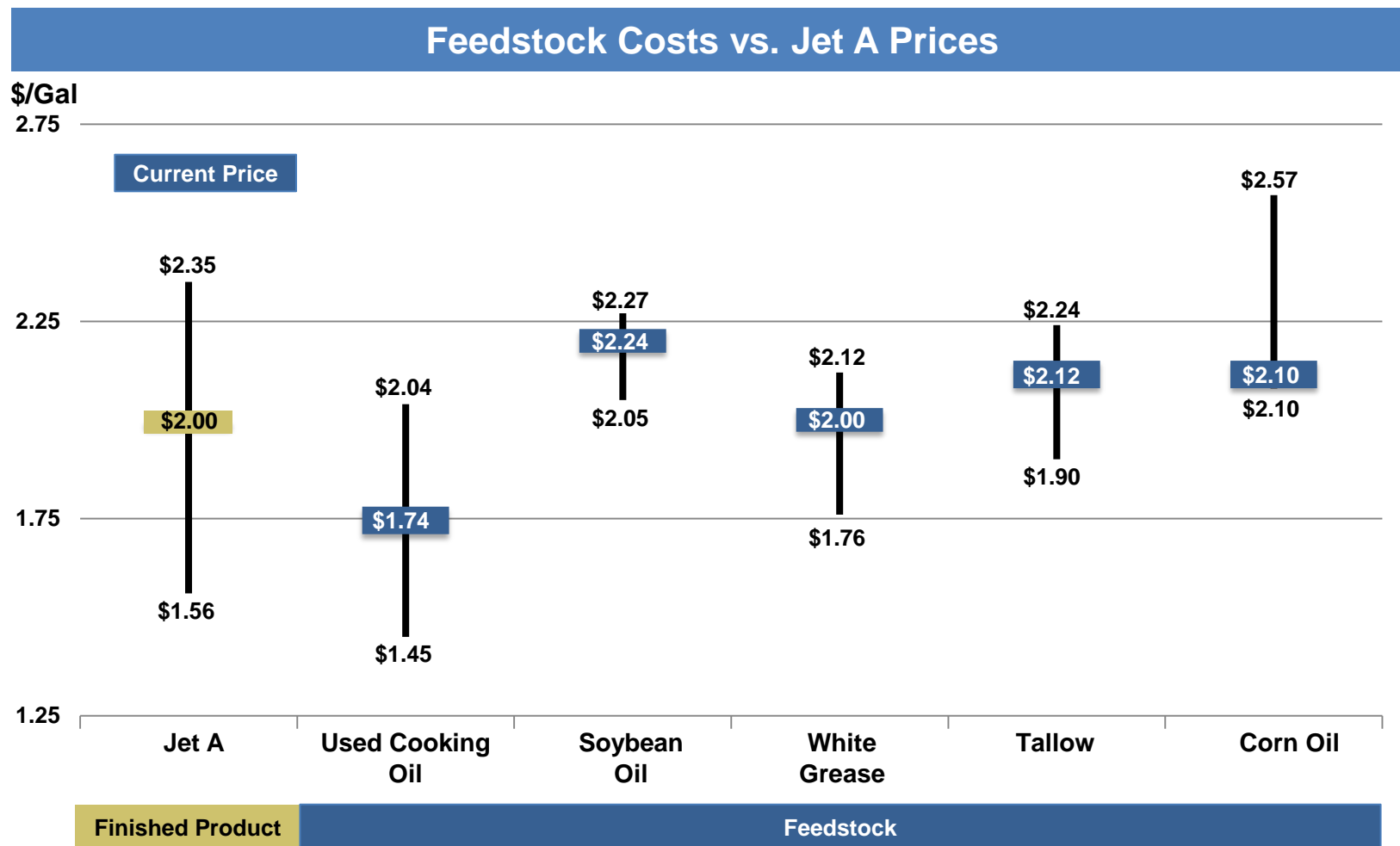
Most RJF production to date has utilized the HEFA pathway.

Sources: EIA, ICAO Presentation by Mark Rumizen: Alternative Jet Fuel Certification, February 2017; OP Research and Analysis.

(1) On April 1, 2018, ASTM approved ethanol as a feedstock for ATJ-SPK and increased the max blend from 30% to 50%.

Feedstock Costs

Feedstocks alone cost as much as JetA.

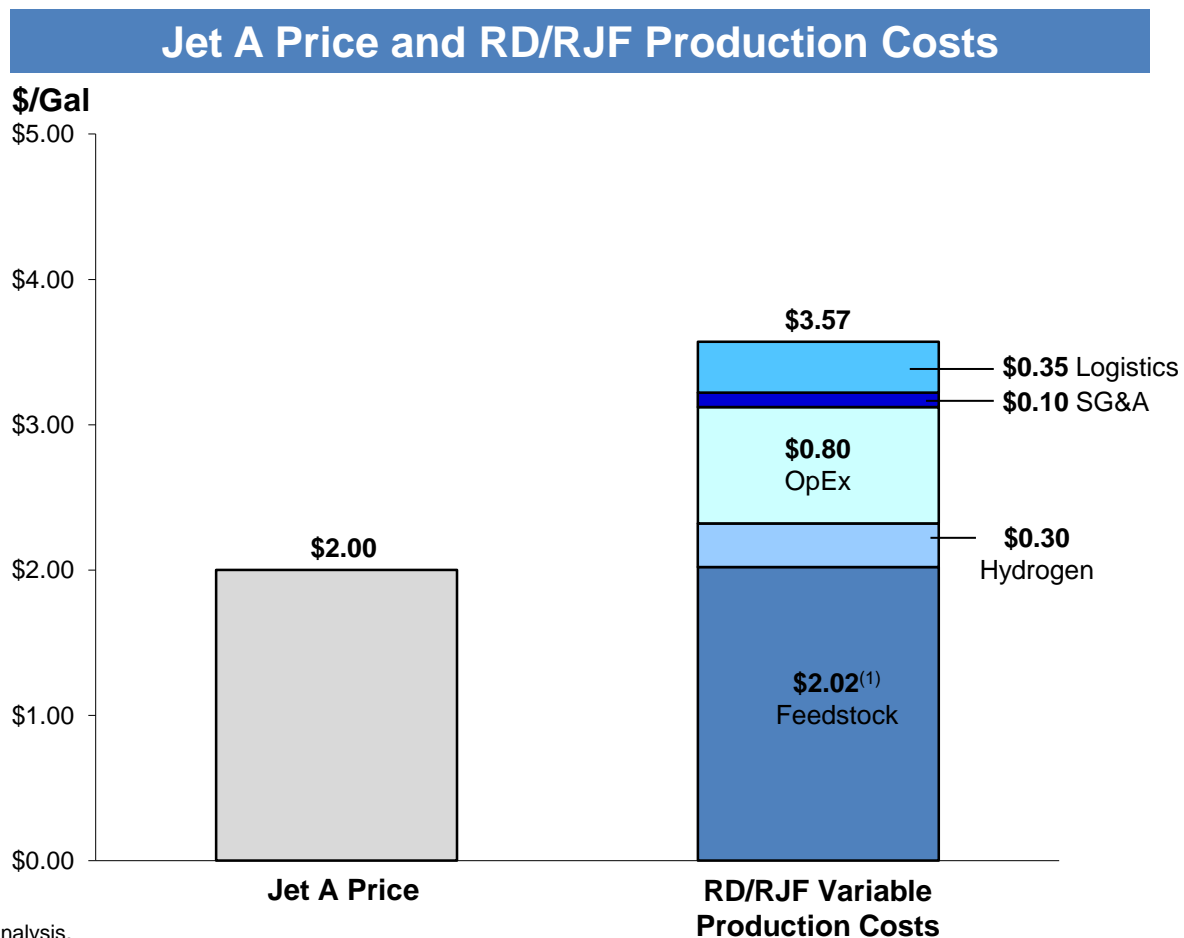


Source: OPA Research, WSJ, EIA and USDA

Based on conversion of 8.5 lbs/gal for UCO, 7.5 lbs/gal for SBO, 8.0 lbs/gal for White Grease/Tallow and 8.2 lbs/gal for Corn Oil

Illustrative Production Costs

Adding production costs, RD/RJF costs at least \$1.57/gallon more than JetA.



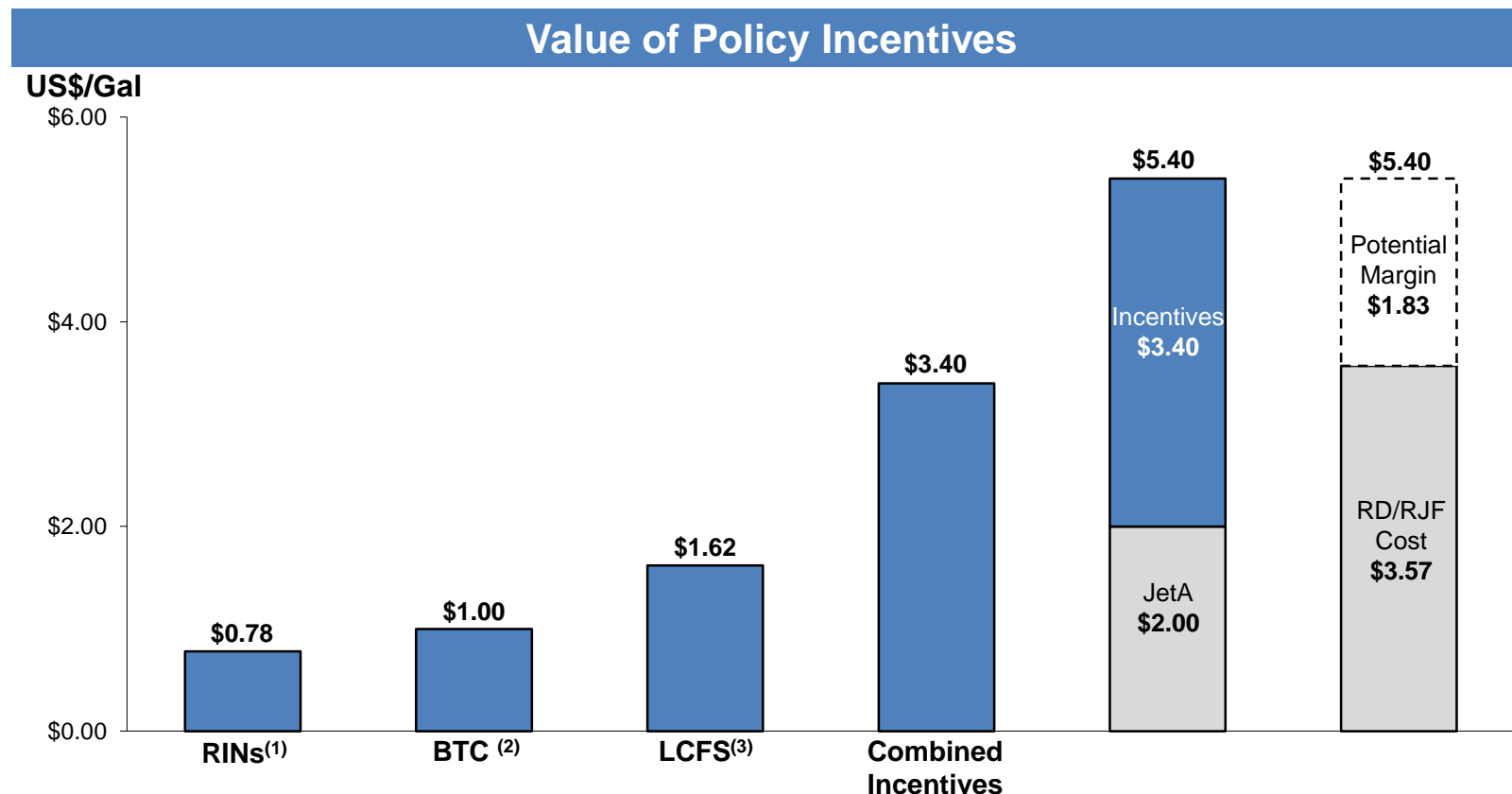
Source: OP Research and Analysis.

Note: Prices as of February 19, 2019. **Analysis does not account for capital costs.**

(1) Based on 8.0 lbs. of feedstock at an average feedstock cost of \$0.25/lb.

Policy Incentives Bridge the Gap

US and California programs provide over \$3/gallon to RD/RJF.



Would the market pay this premium? Why sell RD/RJF anywhere other than California?

Source: OP research and estimates. Prices as of February 19, 2019.

(1) Based on D4 RINs value of \$0.78/gal for RD (\$0.46 x 1.7 factor). RJF factor is 1.6.

(2) BTC expired as of 12/31/17.

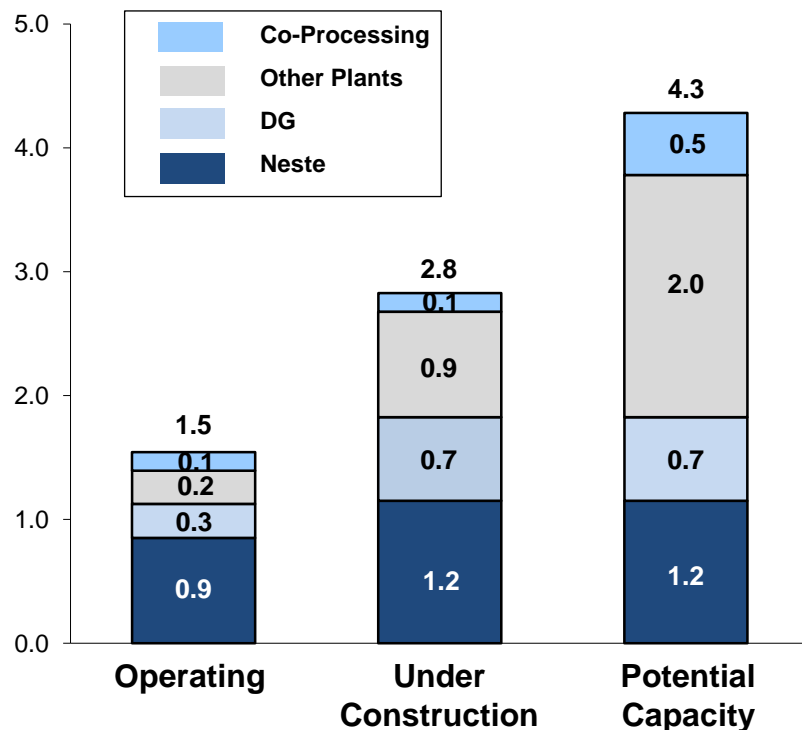
(3) Based on credit price of \$180/MT and conversion of tallow to renewable diesel with a CI Score of 30. RD conversion CI scores range from 20 to 40.

The Boom in RD Plant Construction

The industry has responded to the price signals and high margins.

Global RD Plants: 2019 and Beyond

BGPY



Industry Landscape

- Neste and DG will be at 1.8 BGPY by 2022.
- Co-processing at oil refineries has begun but is not transparent. Ocean Park estimates:
 - 150 MGPY in operation.
 - 500 MGPY by 2022.
- 1.3 BGPY of announced projects including 5 new facilities/expansions or more co-processing.

Where Is the Feedstock?

- Just the capacity under construction will use 60-65% of US waste feedstocks.
- Other announced capacity would use another 70-75% of the US supply.

Sources: Company filings and press releases; The Jacobsen Biofuels Forward Curve Report (May 24, 2018); OP Research and Analysis.

Note: Figures include an estimated 150 MGPY of co-processing production operating, growing to an estimated 500 MGPY through proposed projects by 2022.

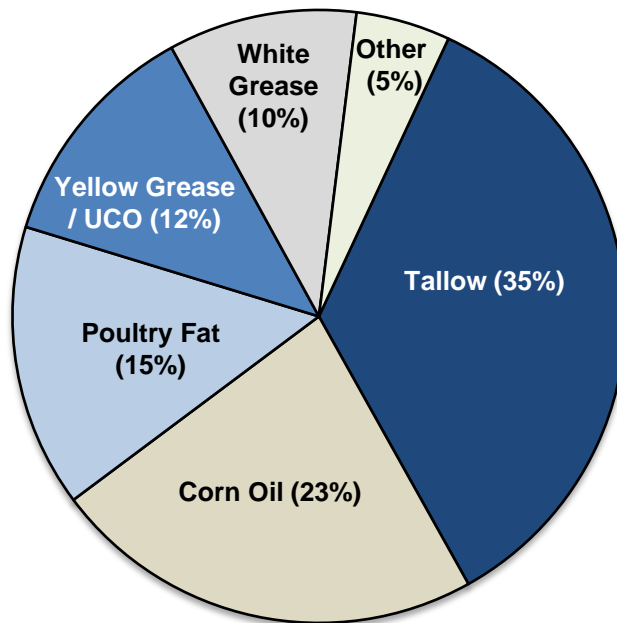
Note: Numbers may not add up due to rounding.

US Waste Feedstock Supplies

These “waste” feedstocks are all by-products, so supply is relatively inelastic.

2017 US Waste Feedstock by Source

16.3B lbs. (8.1M Tons)



Comments

- These are not actually “waste” feedstocks.
- Numerous applications and markets for these feedstocks.
 - Feed.
 - Soaps and Detergents.
- 2013 - 2017 CAGR – 7.2%.
- 2017 - 2018 growth – 4.5%.
- As a reference – annual US soybean oil supply is about 24B lbs.

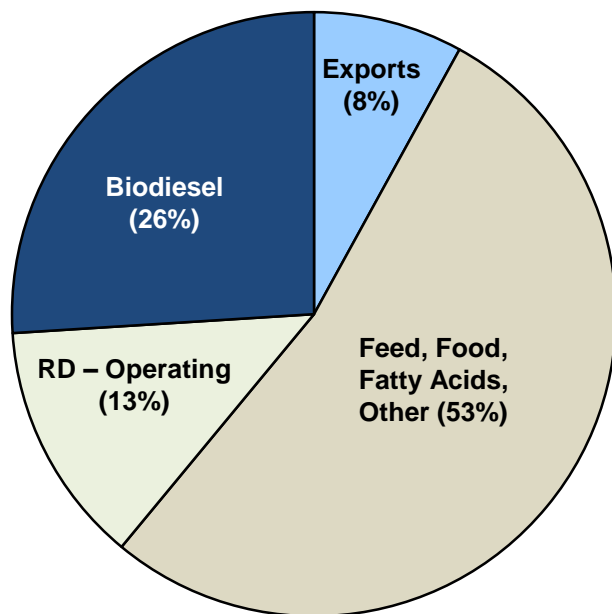
Source: National Agricultural Statistics Service (NASS).

Crowded Demand for Waste Feedstocks in the US?

If all announced capacity is completed, renewable fuels will use 98% of US waste feedstocks.

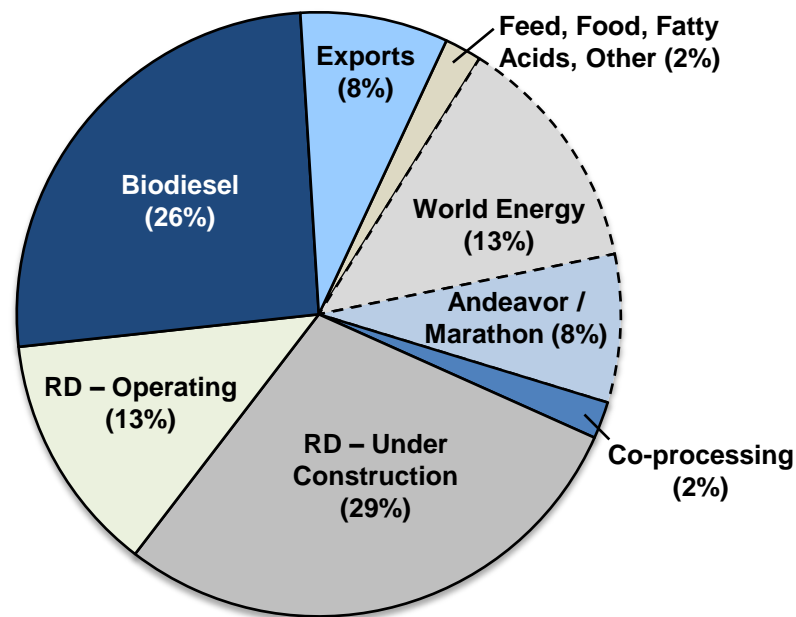
2017 US Waste Feedstock by Use

16.3B lbs. (8.1M Tons)



Increased Demand for 2017 Waste Feedstock

16.3B lbs. (8.1M Tons)



If all the waste feedstocks in the US converted into RJF, they would produce 2 billion gallons – about the annual fuel usage at LAX.

Sources: EIA; National Agricultural Statistics Service (NASS); Render Magazine April 2018 Edition; OP Research and Analysis.

Insight From the Market Leader

When completed in 2021, Darling's single RD plant will account for 35-40% of the North American fat market.

“...the marketplace has not seen the new 115M expansion...that's another 1 billion pounds... another 6% to 8% of U.S. supply...”

...and when we bring Super Diamond on...you're about 6 billion pounds...1 out of every 2.5, 3 pounds of North American fat has to end up in a half square mile in New Orleans. So I suspect it will make a pretty nice Harvard case study one day as to what dislocation of what markets happens and what the ultimate price of fat [is].

It's driven by carbon intensity...There's a lot of fat in the world to use, whether it's palm oil, soybean oil, canola oil, sunflower oil. But it doesn't have the carbon intensity scores that the waste fats and greases and distillers corn oil has...we will chase that product. And if there is any other competition that comes out there, they will too, and the impact will be to drive that price up.”

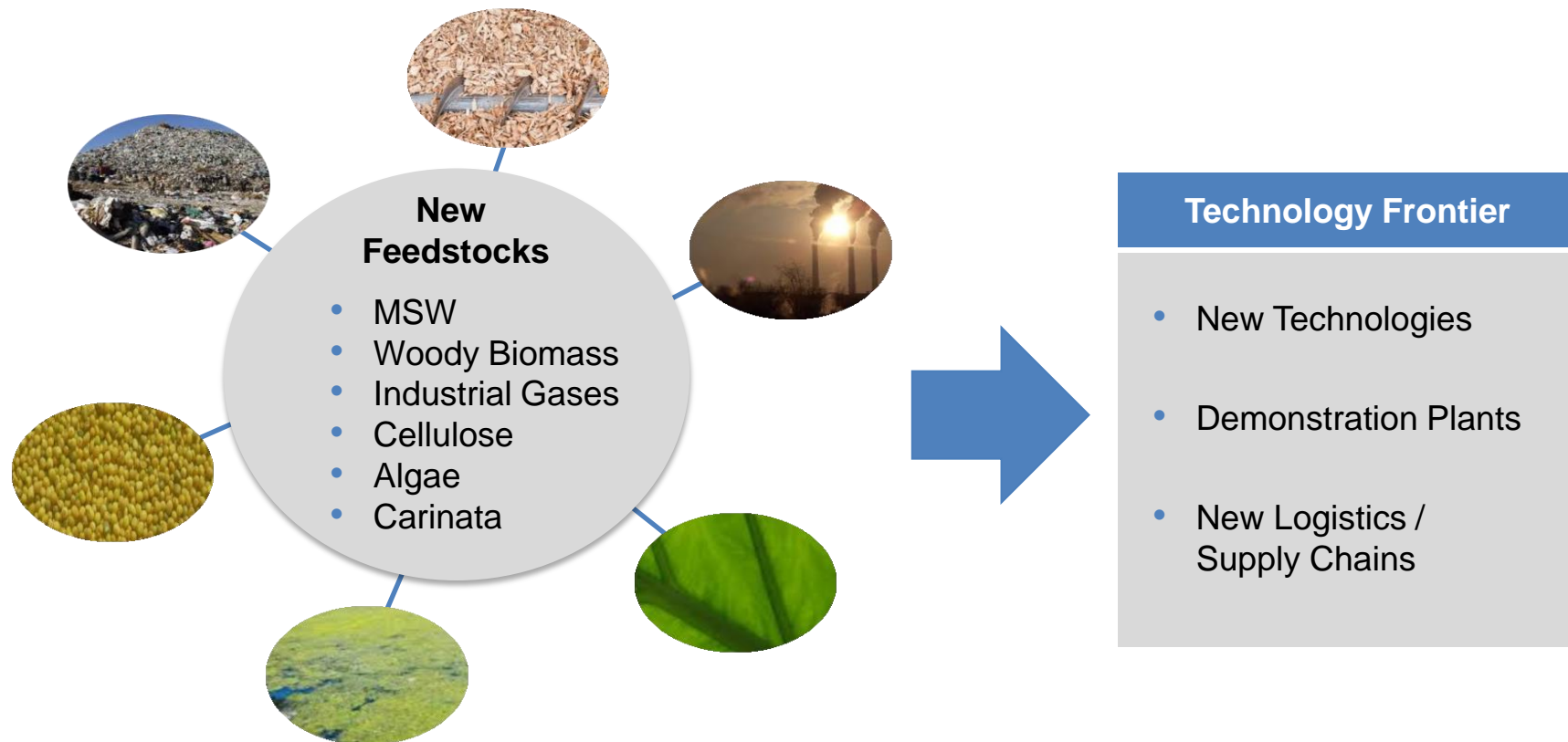


Randall C. Stuewe
Chairman & CEO

2018 Q3 Earnings Call

The Frontier of New Feedstocks and Technologies

Several companies are developing projects and technologies to process new feedstocks.



Rolling out new renewable fuel technologies takes decades not years, billions not millions.

- It took 30 years and \$25B for ethanol to reach 10% of US gasoline supply.
- After 22 years and \$2-3B, biodiesel has reached 3% of the US diesel market.

Sources: Company Websites; OP Research & Analysis.