The Department of Energy: Wet and Gaseous Feedstocks: Barriers and Opportunities
Berkeley, CA
June 07, 2017

• **Location**	Paramount, California
• **Process Technology**	Catalytic Hydrotreating (Honeywell-UOP)
• **Production Capacity**	3,000 bbls/day
• **Feedstock**	Inedible agricultural fats and oils
• **Products**	Renewable F-76 and JP-5 Renewable Jet, Diesel and Gasoline

Significant Use of Reconfigured Assets….

The AltAir Paramount project reconfigured existing equipment significantly reducing capex and expediting several permitting requirements relative to a similar greenfield facility

Supplemented with New Equipment…

The AltAir Paramount project also highlights a repeatable process that can be used to efficiently deploy similar conversions at other refineries

	Equipment Description
No. 5 HDS Unit	> Reactor charge pump > Recycle gas compressor > Reactor feed / effluent heat exchangers > Reactor charge heater / stripper reboiler > Reactor effluent air condenser > Reactor product separator > Recycle gas amine scrubber KO drum > Recycle gas amine scrubber tower > Recycle gas compressor KO drum
Penex Unit	> Penex reactors > Feed / effluent heat exchangers > Reactor charge heater
Offsite	> Tallow feed tank > Vegetable oil feed tank > Diesel rundown tanks > Jet rundown tanks > Finished diesel tank > Finished jet tank

	Equipment Description
Select New Equipment Purchased	> Reactor feed / effluent heat exchangers > Pretreat reactor > Deox reactor > Reactor effluent air condenser > Reactor product separator > Reactor charge pump > Fractionation tower > Hydrogen from Praxair facilities

Great Green Fleet
San Diego– January 20, 2016

LAX – Los Angeles World Airports
March 11, 2016

UNITED

World Fuel Services

Gulfstream
A GENERAL DYNAMICS COMPANY

AMERICA'S NAVY

SOUTH AFRICAN AIRWAYS
A STAR ALLIANCE MEMBER

BOMBARDIER
the evolution of mobility

KLM
Royal Dutch Airlines

SINGAPORE AIRLINES

Los Angeles World Airports

UPS

Oslo Airport

Preferred Compliance Fuel

	Petroleum ULSD	*Biodiesel (FAME)*	*Green Diesel*
Oxygen Content, %	0	11	0
Specific Gravity	0.84	0.88	0.78
Cloud Point, °C	-5	-5 to +15	-20 to +10
Cetane	40 - 52	50-65	70-90
Sulphur, ppm	<10	<2	<2
Energy Density, MJ/kg	43	38	44
Polyaromatics, vol-%	4 - 12	0	0
Colour	Clear	Light to Dark Yellow	Clear
Oxidative Stability	Baseline	Poor	Baseline

Pure hydrocarbon means:
-Engine Compatibility
-No Blend Wall
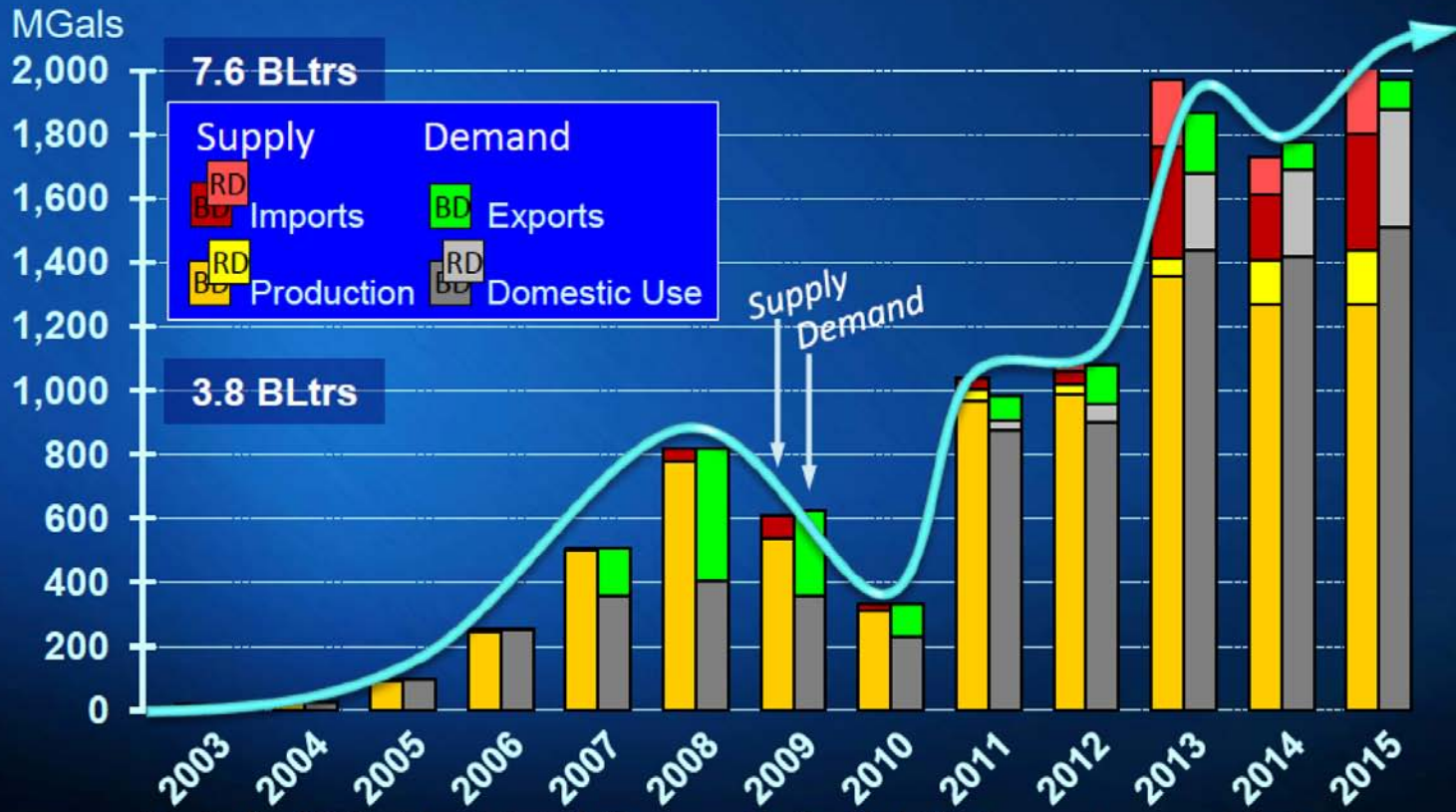-Storage and Logistics Infrastructure Compatibility

LA CARB Diesel + CAR + LCFS Fee - ?

- AltAir is primarily a rack seller
- In-State ratable production is advantageous
- Blender credit lapse has reduced volume and consistency of imports
- Reduced supply relative to demand combined with increasing product familiarity has facilitated near price parity with petroleum diesel

Meets fuel performance requirements
Requires NO change to airplanes or engines
Requires NO change to infrastructure
Can be mixed or alternated with Jet-A fuel

- ASTM standard approved in May 2011 for up to 50/50 blend of Biojet and Jet-A

Renewable Jet

- ☑ Freezing point
- ☑ High temperature thermal stability
- ☑ Energy density
- ☑ Storage stability

- ☑ Elastomeric compatibility
- ☑ Must be a replacement solution
- ☑ Meet ASTM fuel specs
- ☑ Have a low CO_2 footprint

Synthetic Paraffinic Kerosene (SPK) from a Bio-Derived Source					
Property		Jet A or Jet A-1	SPK		ASTM Test Method
			Camelina Jet	*Algae Jet*	
Fluidity					
Freezing point, degrees Celsius	**max**	**-40 Jet A**	**-63**	**-55**	**D 5972, D 7153, D 7154, or D 2386**
		-47 Jet A-1			
Combustion					
Net heat of combustion, MJ/kg	**min**	**42**	**44.0**	**43.5**	**D 4529, D 3338, or D 4809**

* Data Provided by UOP

23 °C Lower Freeze Point

Nearly 4% more energy content

The Challenge: Carbon-Neutral Growth

CO$_2$ Emissions

Forecasted Emissions Growth w/o Reduction Measures

Ongoing Fleet Renewal / Technology Development

ATM Investments / Operational Improvements

Sustainable Fuels

Baseline
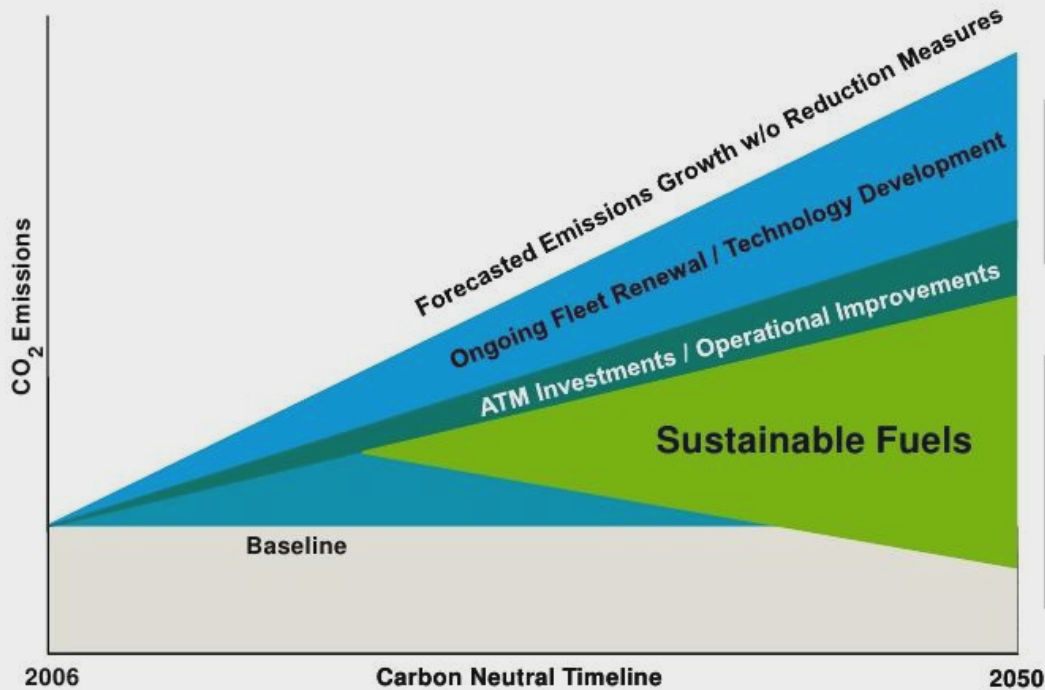
Using less fuel
- Efficient airplanes
- Operational efficiency

Changing the fuel
- Lower lifecycle CO$_2$
- No infrastructure modifications
- "Sustainable Biofuel"

2006   **Carbon Neutral Timeline**   2050

Sustainable aviation biofuel is an essential growth enabler

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Renewable Naphtha + Petroleum Blendstock + Ethanol

- Naphtha is the third hydrocarbon product produced with jet and diesel
- Finished gasoline is approximately 50% renewable material
- Approved RFS pathway for D5 RIN generation
- LCFS pathway application being processed

- From 2005 to 2010, biomass-based diesel's usage of feedstock increased to over 2 billion lbs.

- From 2010 to 2015 this usage increased over 370% to over 9.9 billion lbs.

- Primary incremental feedstocks are yellow grease and the onset of DCO availability.

- From 2015 to 2026, usage is projected to increase approximately 65%.
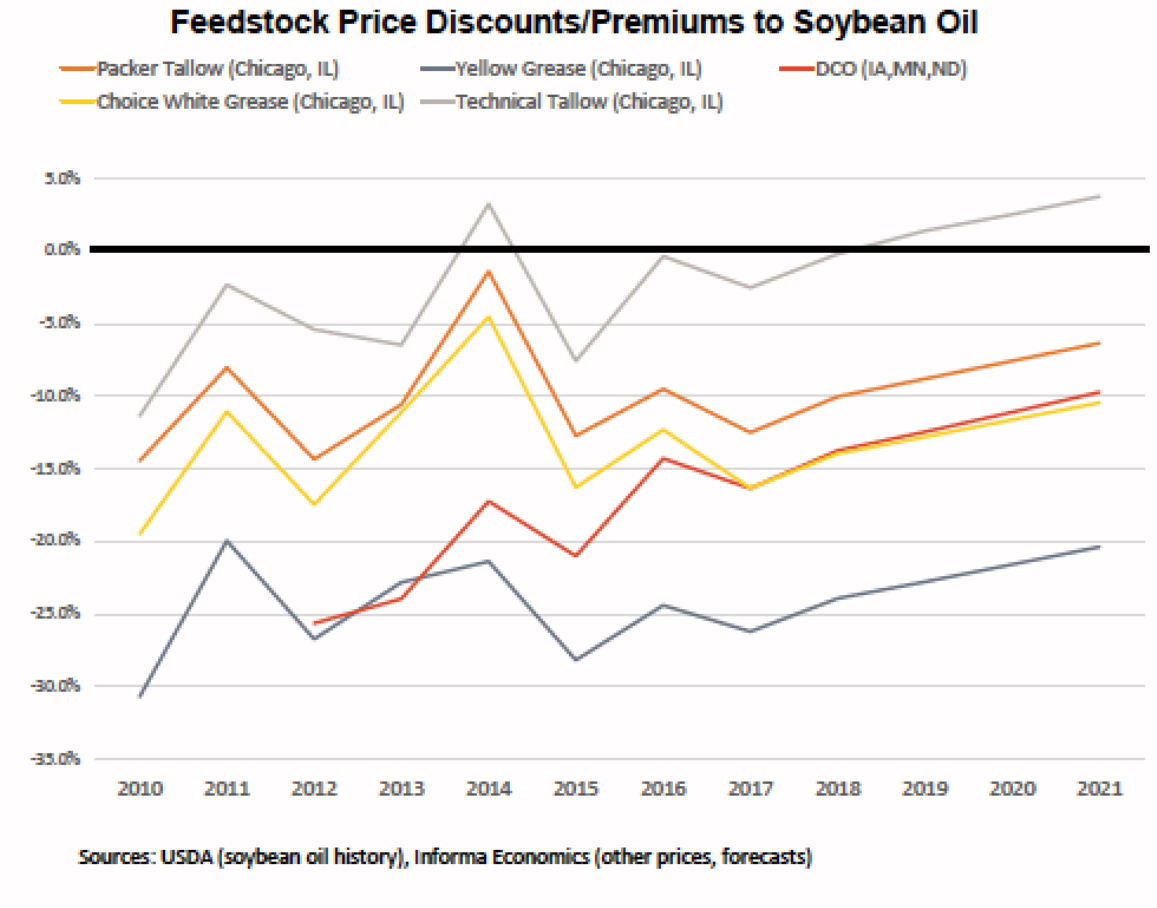

2010-2015 Biodiesel Growth
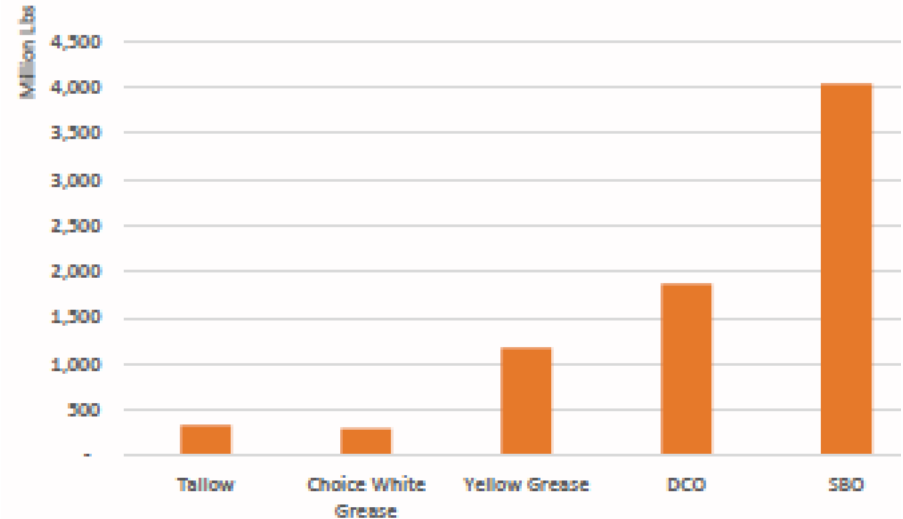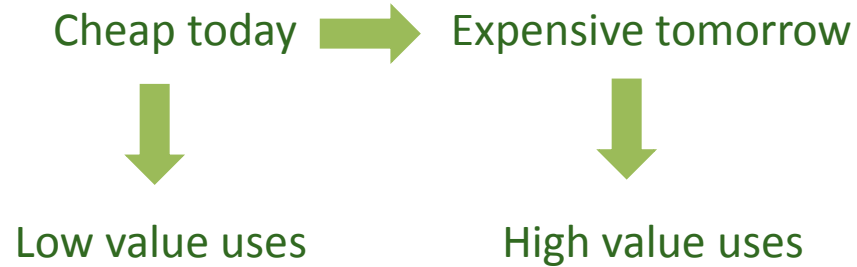

2015-2021 Biodiesel Projected Growth

Informa Economics

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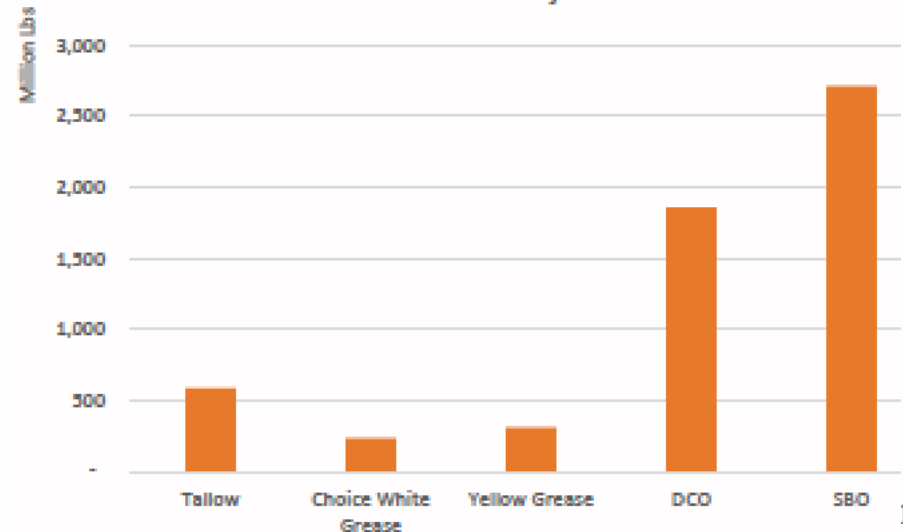
- Prices for most biomass diesel feedstocks are tied very closely to soybean oil.

- However, the price discount to soybean oil has been narrowing over the past several years due in large part to the California LCFS and the demand for low-CI fuels. As the California LCFS regulations tighten, the carbon price increases, which in turn increases the value of feedstocks that produce low CI fuels.

- The prices of most feedstocks are expected to remain at a discount to SBO, though the discounts are expected to narrow

Feedstock Price Discounts/Premiums to Soybean Oil

— Packer Tallow (Chicago, IL) — Yellow Grease (Chicago, IL) — DCO (IA,MN,ND)
— Choice White Grease (Chicago, IL) — Technical Tallow (Chicago, IL)

Sources: USDA (soybean oil history), Informa Economics (other prices, forecasts)

Cheap today ➡ Expensive tomorrow

⬇ ⬇

Low value uses　　　High value uses

Low CI = More Credits = More Value ($) = More Demand = Higher Feed Price

- **2018 RVO and the 2019 biomass-based diesel requirement**

- **Americans for Clean Energy, Inc. et al. v. EPA, et al**

- **Requests to EPA for change of RFS Point of Obligation**

- **Renewable Enhancement and Growth Support Rule**
  (E85 clarification, additional credit options, biointermediates, etc.)

- **Potential legislative reform of RFS**

- **Argentinian anti-dumping/countervailing duty case**

- **BTC vs PTC, if anything**

- **2 POET, LLC and others v. California Air Resources Board LCFS lawsuits**

Thank You