Parade of Commercialization Efforts, part 2

Moderator: Stephen Kramer (Pratt & Whitney)

Panelists:
Chuck Red (ARA)
Joanna Bauldreay (Shell)
Michael Lokey (Sunshine Biofuels)
Nick Andrews (USA BioEnergy)

CAAFI®
COMMERCIAL AVIATION ALTERNATIVE FUELS INITIATIVE

Early-stage entity collaboration

* R&D Team Engagement with companies who are proposing a technology not already qualified
  * Intended to assist entry in ASTM D4054 activities, e.g.:

ALGENOL, Anellotech, ARA, Capergy, GRI, Enerkem, FORGE HYDROCARBONS, coolplanet, Genifuel, Global Bioenergies, Greenfield Global, Licella, MB, Proton Power, Primus Green Energy, Shell Aviation, SBI BioEnergy Inc., steeper energy, Sunshine Biofuels, Vertimass

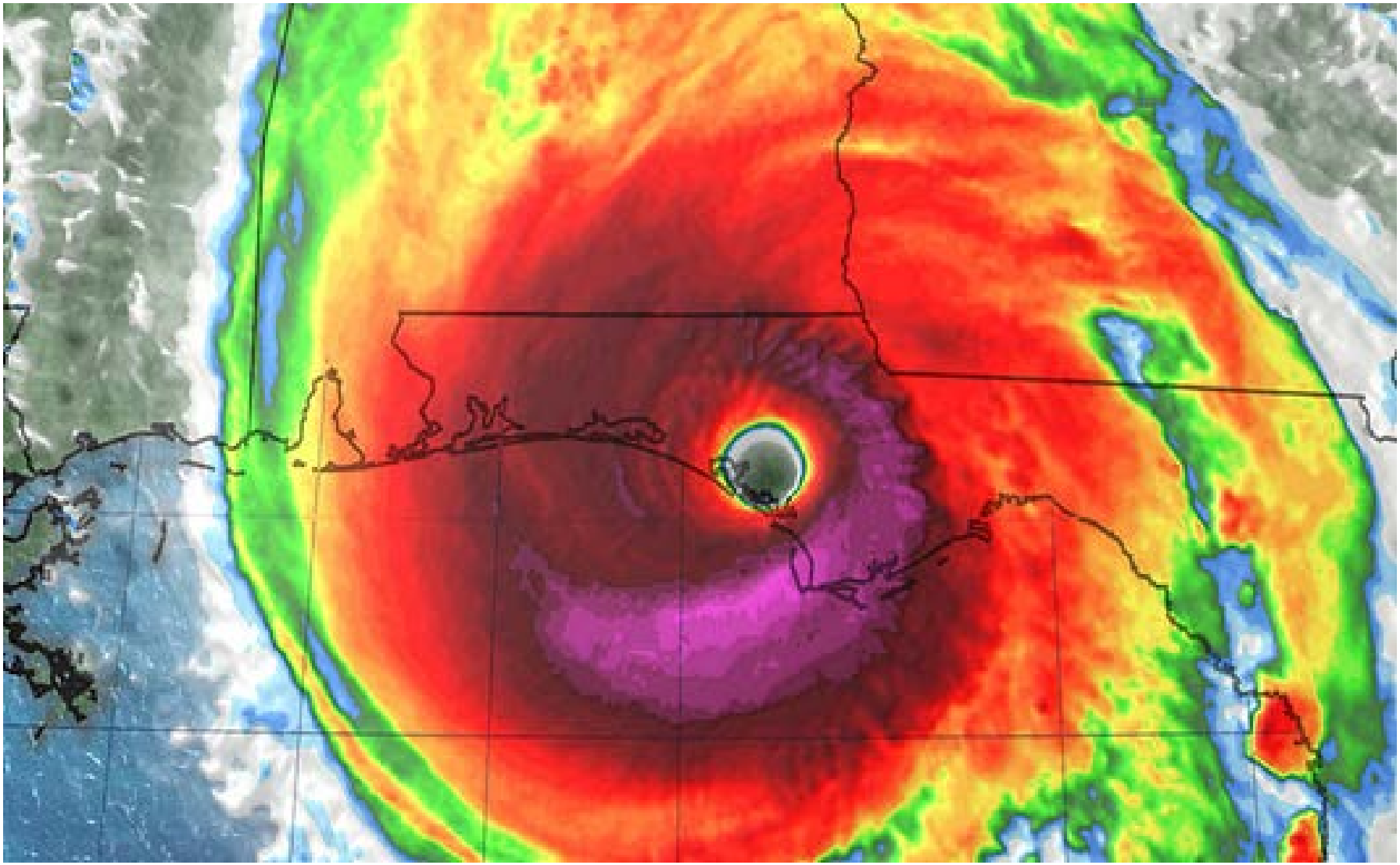
* New Companies simply commercializing with known technology – engagement path with Business Team (CC & CERL), e.g.:

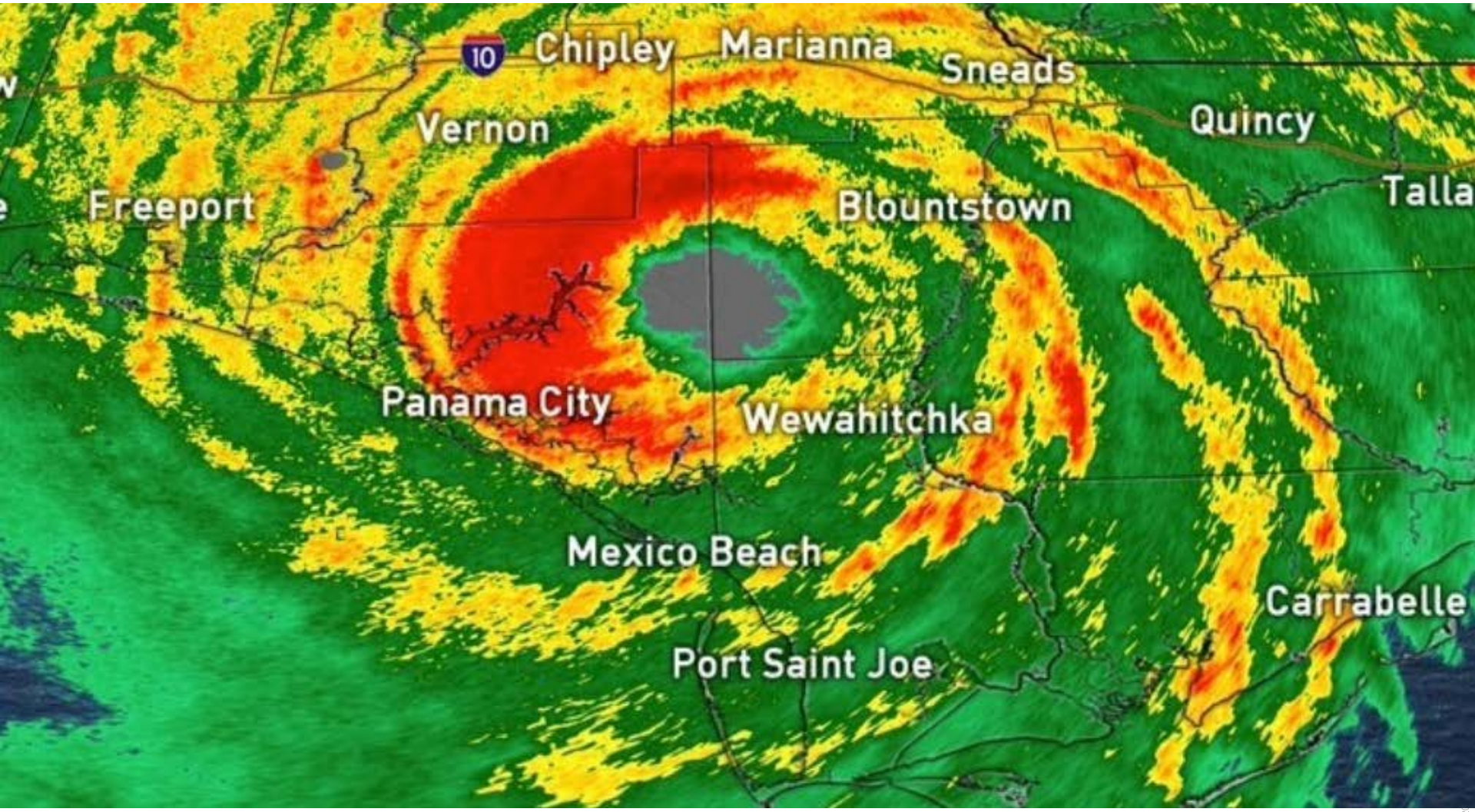
Carbon Engineering, NuFuels, USA BioEnergy, CAAFI

ReadiDiesel™ ReadiJet™

Biofuels ISOCONVERSION Commercialization

Chuck Red
cred@ara.com
850.628.0332





1st 100% Renewable Fuel Jet Flight

Oct 2016 1st 100% Renewable Fuel Military Jet Flight

1st 100% Renewable Fuel Single Engine Military Jet Flight

Process Background

Biofuels ISOCONVERSION

Converts fats, oils, and greases from plants, animals, or algae into “drop-in” renewable fuels

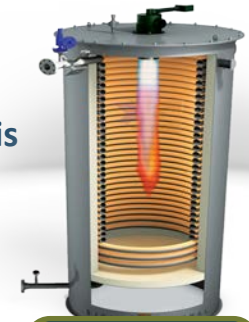
ARA

Hydrothermal Cleanup

- Rapid hydrolysis
- Separates clean free fatty acids from inorganics and glycerin

Catalytic Hydrothermolysis

- Supercritical water process
- Produces crude oil that contains the same hydrocarbon types as petroleum crude



2 Minutes
Converts fats oils and greases to crude oil

Hydrotreating

- Saturates olefins
- Removes residual oxygenates

Conventional
Refinery Processes

CLG
Chevron Lummus Global

Fractionation

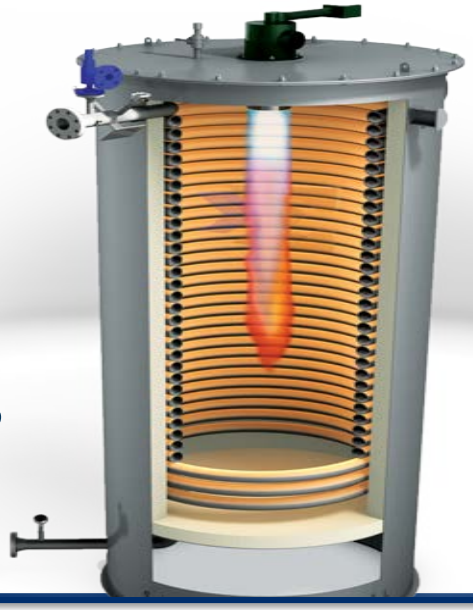
- Produces finished fuels
- Jet and diesel that meet
- Meets petroleum specs without blending
- Renewable chemicals, and naphtha

Hydrothermal Cleanup

- Achieves rapid hydrolysis in a single step
- Produces clean free fatty acids and lipids
- Enables processing of very challenging feed stocks
  - High phospholipid feedstocks
  - High metals content – UCO, brown grease
  - High soap content feedstocks
- Enables recovery of glycerin or valuable fatty acids
- Low-cost, abundant waste fat, oil, and grease feed stocks result in game-changing economics
- Received $3M DOE grant for brown grease research

Catalytic Hydrothermolysis (CH)

- Supercritical Water Process
- Conversion of lipids and free fatty acids to:
  - Normal paraffins
  - Isoparaffins
  - Cycloparaffins
  - Aromatics
  - Smaller organic acids
- Reaction Space Time < 2 minutes
- Product is a light crude oil

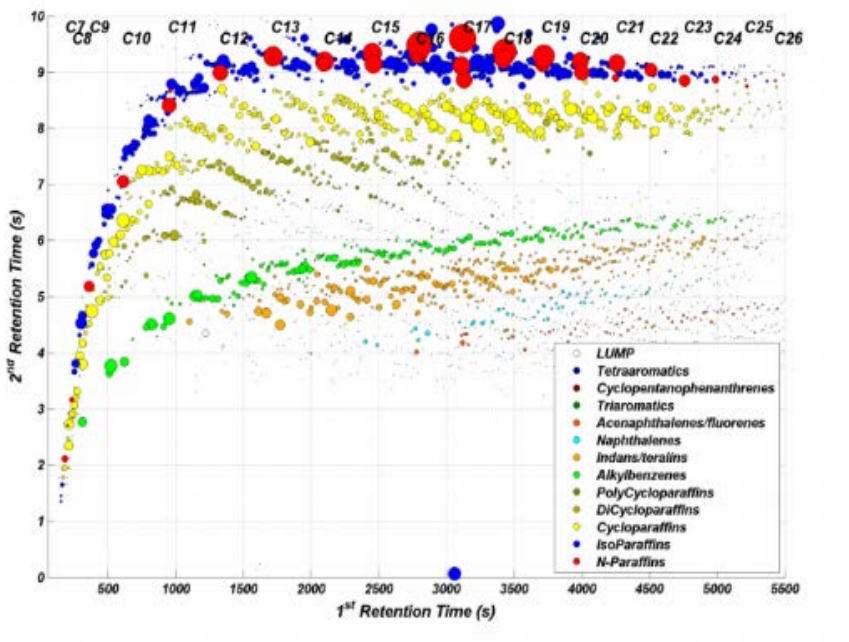


Hydrotreating and Fractionation

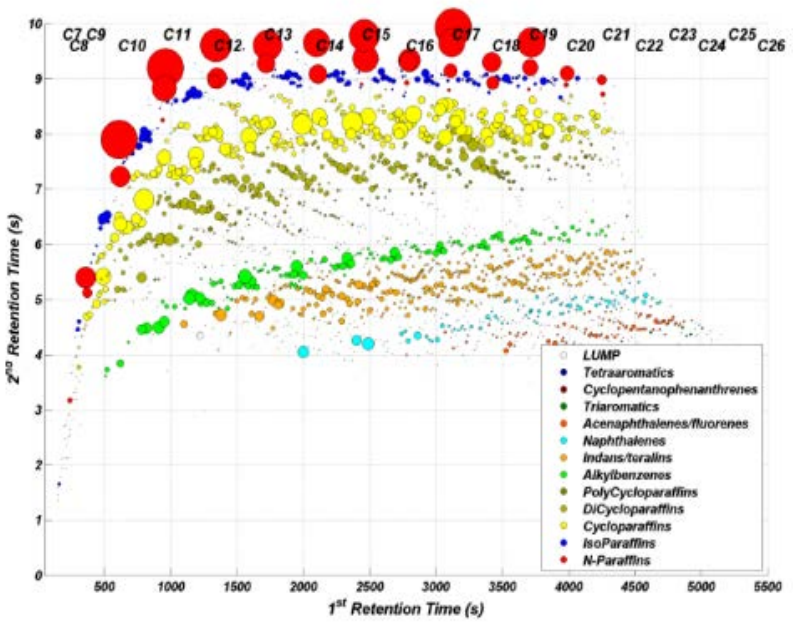
- Conventional Hydrotreating
- Commercial catalysts
  - No precious metal catalysts
- Product is a pure hydrocarbon
  - High yields of diesel fuel
- Good jet yields plus naphtha

GC X GC

Petroleum Jet Fuel



ReadiJet



Gas Chromatograph – Each bubble represents a different compound and the size represents its prevalence.
ARA fuels have same compounds and boiling range distribution as their petroleum counterparts.
Red bubbles represent paraffin molecules.
Yellow bubbles represent cycloparaffin molecules
Green bubbles represent aromatic molecules

Biofuels ISOCONVERSION Products

ReadiJet Jet-A (50:50 blend w/petroleum)

ReadiJet CHCJ-5 – Renewable JP-5 Jet Fuel for Shipboard Use
100% drop-in - unblended

ReadiDiesel CHD-76 – Renewable F-76 Marine Diesel, D975 Diesel
100% drop-in - unblended

Renewable Naphtha

Renewable Chemicals – High value by-products including renewable alkyl aromatics, paraffins, acids, fatty alcohols

Products are pure hydrocarbons with the same boiling range and molecular makeup as their petroleum counterparts

Test Facility – Panama City, FL

Certification

- ASTM Jet Fuel Certification
  - ReadiJet Research Report is in review – CHJ Pathway
  - Anticipate new Annex to D7566 in 2019

Certification

- MILSPEC Certification –
  - Completed testing of 160,000 gallons of fuels under Navy DLA contract
  - Navy stakeholders reviewing data for certification of
    - 100% renewable, drop in, unblended F-76
    - 100% renewable, drop in, unblended JP-5

Commercialization

Joint commercialization effort by Chevron Lummus Global and ARA

Chevron Lummus Global – single point of contact for licensing and engineering

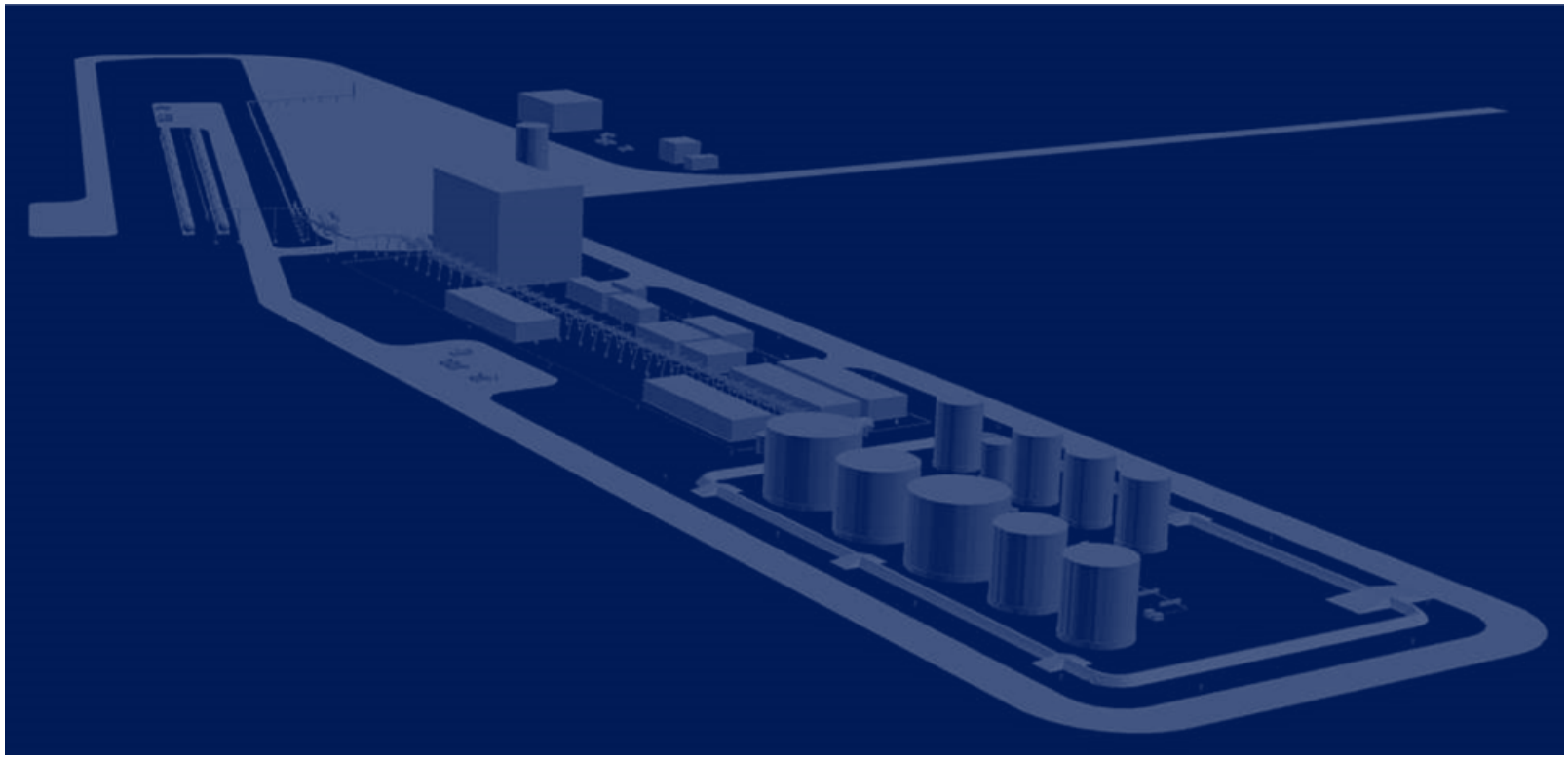
Commercialization

Euglena

- Completed construction of Biofuels ISOCONVERSION demonstration system in Japan
- Planning commercial unit

Commercialization

First Commercial Unit – 3600 BPD



Commercialization

USDA 9003

Biofuels ISOCONVERSION projects greenlighted into phase 2

ARA participating as equity partner

Questions?

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Sunshine Biofuels Introduction

Prepared for: CAAFI
Prepared by: Michael Lokey, CEO, Sunshine Biofuels
Date: 11/30/2018

Sunshine Biofuels

drive clean, save green

- **Founded:** 2011 Lake Worth, Florida
- **Purpose**: To identify and develop the most efficient processes to convert low-value fat and oil commodities into high value fuels, feedstocks, and co-products
- **Mission**: To build the most profitable and efficient renewable oil company in the United States and Caribbean. Our key differentiating strategy is our focus on vertical integration of our supply chain and lean in-house process innovation

Sunshine Biofuels Products & Markets

- Sunshine Renewable Diesel Additive
  - 1.8 Billion Gallon Market
- Sunshine Renewable Diesel Fuel
  - 32 Billion Gallon Market
- Sunshine Alternative Fuel Conversion
  - 8.2 Million Commercial Trucks in US
- Sunshine BioCrude Feedstock
  - 1.2 Billion Gallon Market
- Sunshine Renewable Jet/Diesel Fuel
  - 22 Billion Gallon Market
- Sunshine Renewable Naphtha
  - Renewable Gasoline, pack a lunch

Sunshine Renewable Jet/Diesel Naphtha

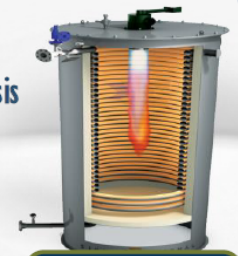
Biofuels ISOCONVERSION Process (BIC)

Converts fats, oils, and greases from plants, animals, or algae into "drop-in" renewable fuels

ARA

Catalytic Hydrothermolysis (CH)

- Supercritical water
- Produces crude oil containing the same hydrocarbon types as petroleum crude



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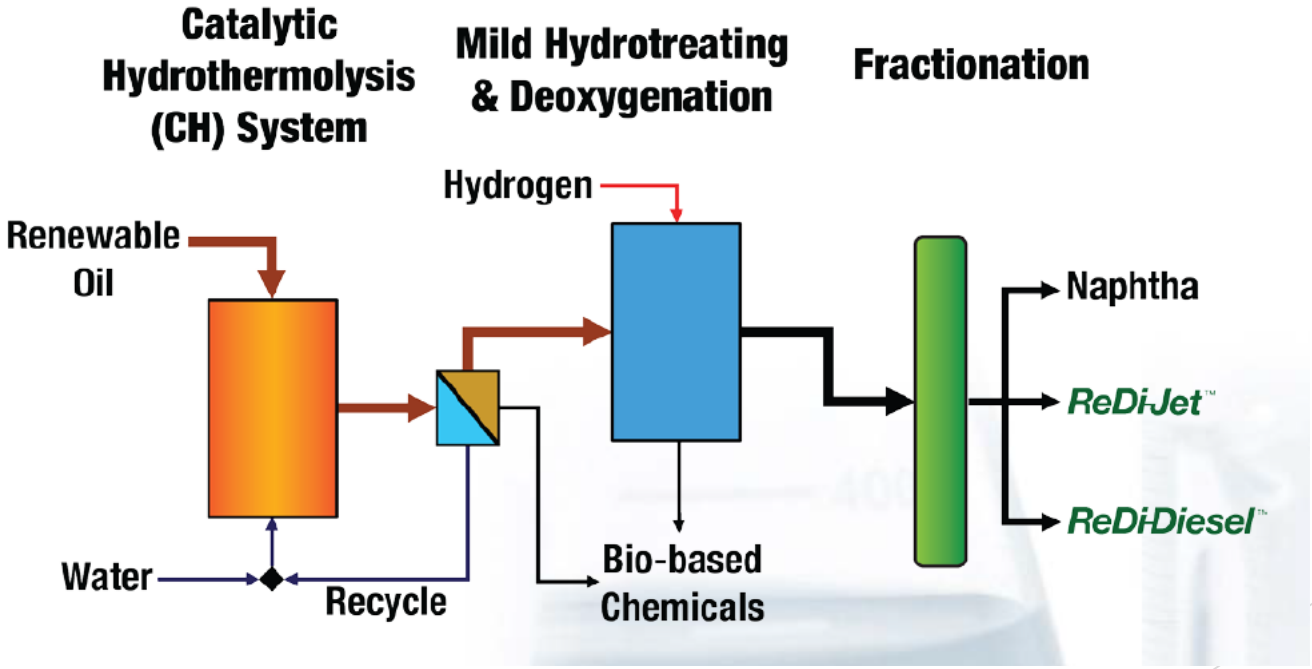
- Renewable chemicals, and naphtha

ARA

SPARC

Sunshine Renewable Jet/Diesel Naphtha

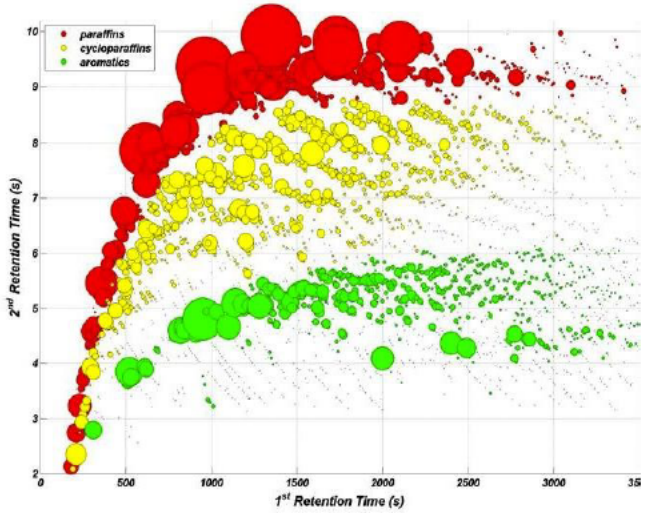
- License Technology from ARA, Chevron Lummus, CB&I
- CAAFI Fuel Readiness Level 7.0; ASTM7566 Mil-Spec 2018
- 168,000 Gallons of Renewable Hydrocarbon Diesel Daily
- 42,000 Gallons of 60 Octane Renewable Naphtha Daily
- Potential for Renewable Crude Production for Co-Processing with Refinery petroleum Crude (~2019)



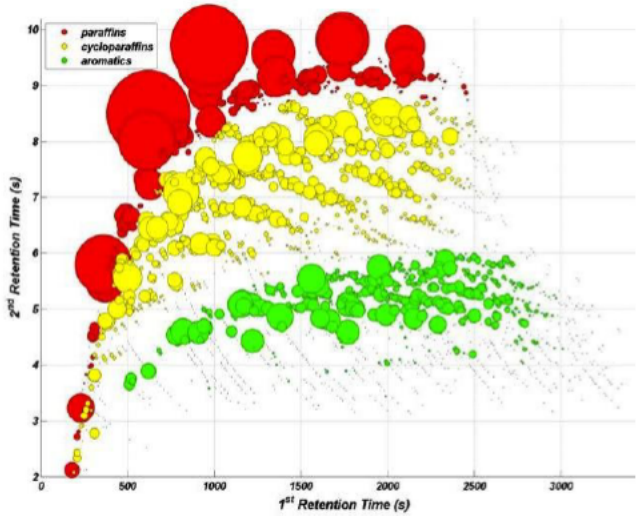
Sunshine Renewable Jet/Diesel Naphtha

Sunshine Biofuels
drive clean, save green

Petroleum Jet Fuel



ReadiJet™



- Gas chromatograph – each bubble represents a different compound (paraffins, cycloparaffins, and aromatics).
- ARA fuels have same compounds and boiling range distribution as their petroleum counterparts.

Sunshine Renewable Jet/Diesel Naphtha

Navy Tests 100-percent Advanced Biofuel

– OCTOBER 17, 2016

POSTED IN: FEATURED STORIES

Drop-in JP-5 jet fuel replacement 'invisible to user'

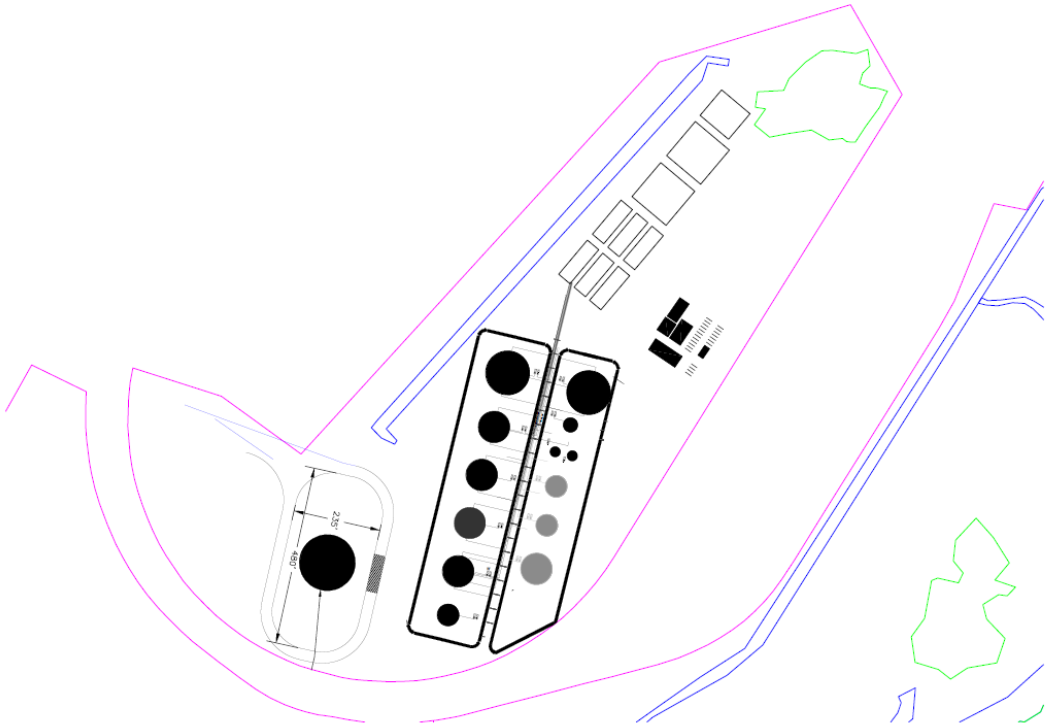
Lt. Cmdr. Bradley Fairfax, project officer and test pilot with Air Test and Evaluation Squadron (VX) 23, takes flight in an EA-18G Growler on 100-percent alternative biofuel during the first test flight Sept. 1 at Naval Air Station Patuxent River, Md. (U.S. Navy photo by Adam Skoczylas)

By Andrea Watters

The Secretary of the Navy's energy vision came to fruition in September when the EA-18G "Green Growler" completed flight testing of a 100-percent advanced biofuel at Naval Air Station Patuxent River, Maryland.

Sunshine Biofuels Tampa, FL

- 70M GPY Isoconversion "drop-in" Renewable Diesel and Jet Fuel
- 50 MGPY Sunshine Renewable Diesel Plant
- 2.5 MGPY BioCrude Refining



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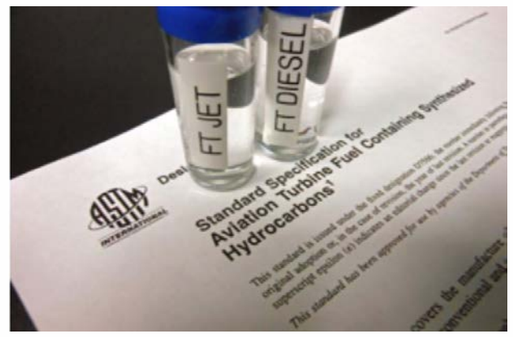
Oregon 19 million gallons per year biorefinery

CASCADIA BIOENERGY



-The Intelligent Biorefinery-

Biomass Gasification to Renewable Diesel & Jet Fuel

Nicholas B. Andrews

CEO

Cascadia Bioenergy, LLC

Springfield, OR

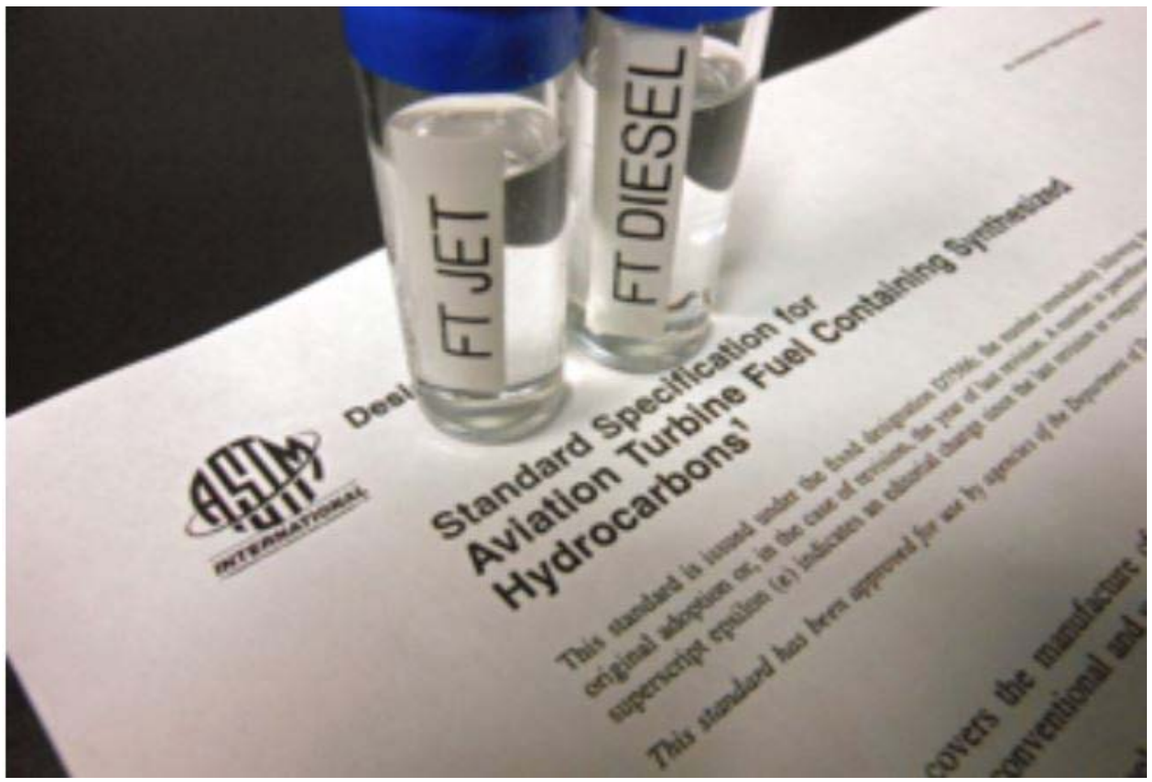
- Introduce USA BioEnergy and it’s Renewable Fuels Projects.

- Review the Advantages of Building Intelligent Biorefineries to Produce Cellulosic Renewable Fuels.

- Our goal here is to get Renewable Jet Fuel purchase agreements.

- Thankful to have this opportunity to introduce USA BioEnergy and it’s Renewable Fuels Projects.

CASCADIA BIOENERGY

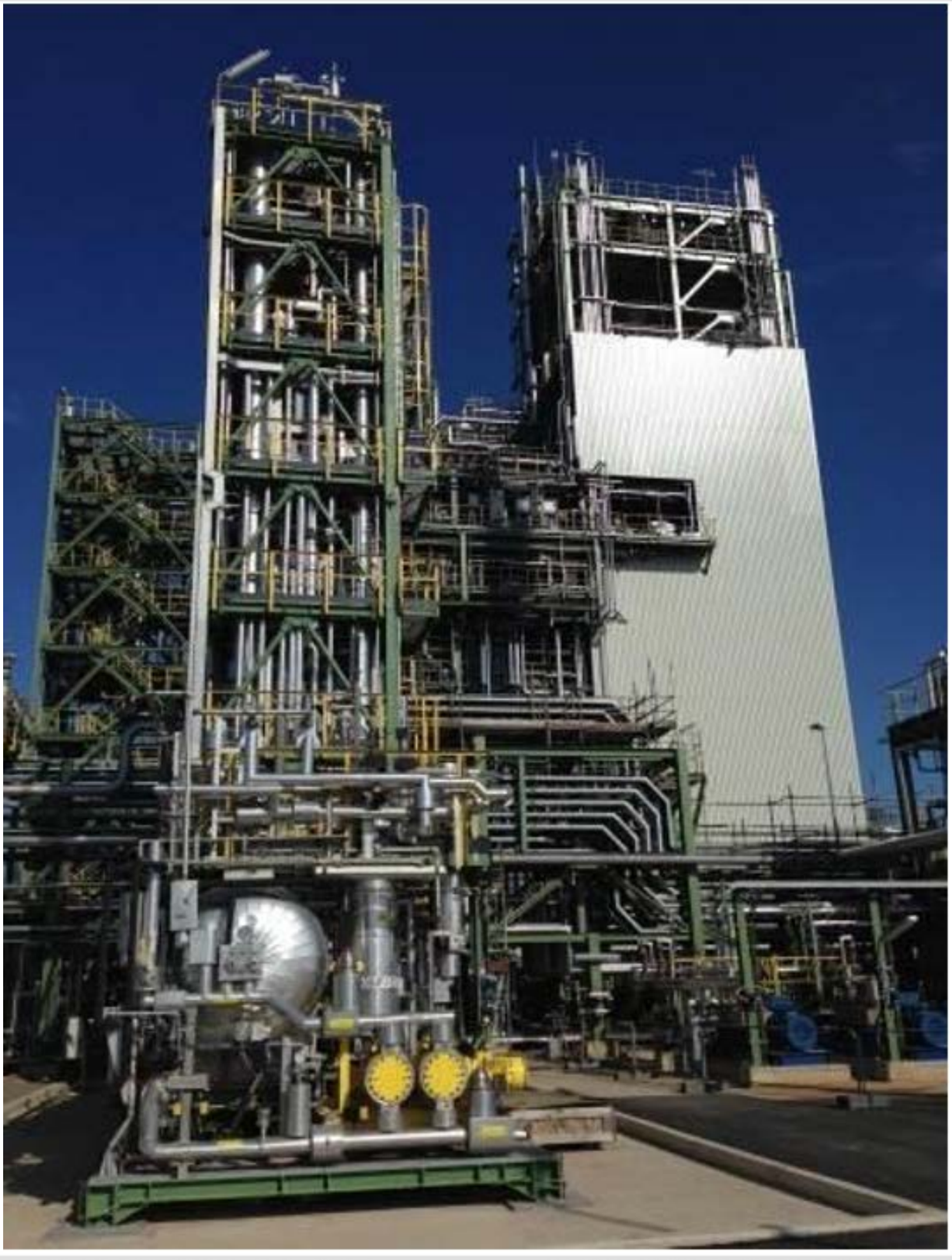


Cascadia Bioenergy, LLC ("CBE) will be among the first wave of second generation, commercial scale, cellulosic renewable bio-fuel refineries in the U.S. being developed by **USA BioEnergy, LLC ("USABE")**.

The technology being used consists of a patented state-of-the-art near zero emission carbon based "wood waste" biomass to fuels technology. The technology also has a highly efficient back-end patented gas-to-liquid ("GTL") conversion system.

It generates <1 ppm Sulfur Drop-In premium ASTM D975 diesel fuel or Commercial and Military grade SPK (synthetic paraffinic kerosene) jet fuel blend component. Presently, cellulosic and advanced biofuels production in the U.S. has been well below the EPA's RFS2 statutory mandated volumes.

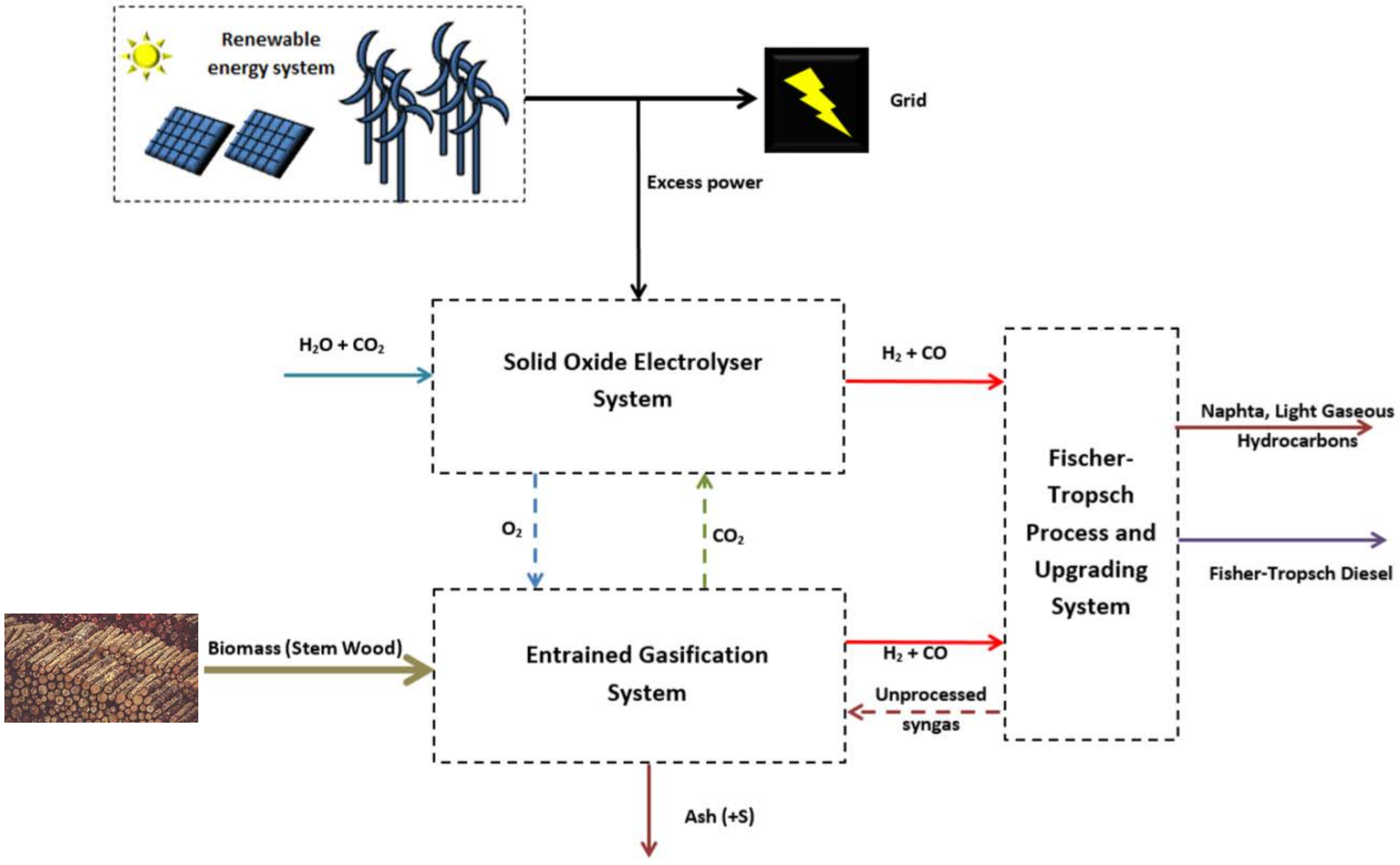
OVERVIEW



- ✓ **Biomass to FT fuels**
- ✓ **Feedstock: Forest residues**
- ✓ **475,000 – 575,000 tons of wood fiber annually**
- ✓ **Biomass gasifier for clean energy**
- ✓ **Fischer Tropsch (“FT”) technology & Hydroprocessing**
- ✓ **Catalyst and gas purification**
- ✓ **Global provider of operations and maintenance**
- ✓ **Leading independent owners engineer and project management**
- ✓ **Country’s leading energy attorney and law firm**
- ✓ **Industry leader in all natural wood products**
- ✓ **Targeting jet fuel and renewable diesel offtakes**
- ✓ **Offtake agreements are currently being negotiated**
- ✓ **19.4 million gallons of premium renewable bio-fuels annually**
- ✓ **Projected development cost professionally estimated / IRR Attractive**
- ✓ **Startup targeted for 2022**
- ✓ **Business model repeatable and scalable with high barrier to entry**
- ✓ **Products qualify for cellulosic RINs & LCFS credits**

EQUITY INVESTORS WHO MEET THE ACCREDITED INVESTOR REQUIREMENTS WILL BE PROVIDED ADDITIONAL INFORMATION

TECHNOLOGY OVERVIEW



10-40% ▼
in Maintenance Cost
Cf. McKinsey Global Institute: Big data: The next frontier for innovation, competition, and productivity

3-5% ▲
in Productivity
Ref: See, for example, ABB case study

20-50% ▼
in Time to Market
Ref: Cf. McKinsey Global Institute: Big data: The next frontier for innovation, competition, and productivity

30-50% ▼
of Machine Downtime
Ref: McKinsey analysis

85+% ▲
in Forecasting accuracy
Ref: McKinsey analysis

45-55% ▲
in Productivity (Automation of Knowledge Work)
Ref: Cf. McKinsey Global Institute: Disruptive Technologies

10-20% ▼
in Cost for Quality
Ref: Cf. T. Bauernhansl, M. ten Hompel, B. Vogel-Heuser(Hrsg.): Industrie 4.0 in Produktion/Automatisierung/Logistik(2014)

20-50% ▼
in Inventory Cost
Ref: McKinsey analysis

Ref: For full article see https://goo.gl/yh1KjN


Cost Reduction
Big Data Analytics
Realtime Tracking Data
Interoperability
Energy Efficiency
IIoT
Operational Intelligence
Better Safety
Improve Efficiency
Predictive Maintenance
Benchmarking

PROJECT PRINCIPALS

Nick Andrews, CEO of USA Bioenergy Mr. Andrews is the founder of USA BioEnergy, LLC. He is a serial entrepreneur, having started successful real estate and corporate investment firms, including a functioning crowdfunding business. Once he entered the renewable fuel business he quickly optioned a site in Arkansas, generated interest from major local businesses in buying renewable fuel, negotiated a funding agreement, and met with dozens of industry leaders to promote his project. Nick has over 25 years of senior level experience managing corporate growth, customization, and implementation related to sales, financing, and development.

Patrick Sweeney, Chairman Mr. Sweeney merged his Syn Tawa Energy, LLC, into USA BioEnergy bringing technology and sites for projects in Oregon and Arizona. Building on 25 years of corporate work in hi tech positions, he launched Transcomp Systems to provide software and services in the waste and recycling industry. After a successful exit in 2011 he founded Syn Tawa to develop renewable energy projects, and he subsequently co-founded DigiSphere Labs to develop software to support Syn Tawa's projects. Patrick has a marketing degree from Santa Clara University.

Robert Freerks, President Mr. Freerks has a 20 year background in synthetic and renewable fuels process and product development. Produced first Fischer-Tropsch fuel used by US Military in diesel and jet aircraft, established ASTM specifications for alternative jet fuels, worked with DOE on fuel field performance demonstration programs. Conducted basic research on emissions performance of synthetic fuels. Conducted lifecycle assessments of multiple renewable and alternative fuels projects.

Paul Oesterreich, VP & Director of Fuel Strategy Mr. Oesterreich has 36 years of experience in the energy industry, primarily in trading and marketing of refined and renewable fuels. He began trading during his 17 years at BP and has become an acknowledged expert in the trading of renewable diesel and jet fuels and the environmental credits associated with them. Paul has a degree in Chemical Engineering from Michigan Tech University.

Kym Arcuri, BTL, GTL, & CTL Adviser Dr. Arcuri is one of the world's preeminent scientists in the fields of biomass to liquids and gas to liquids. In his 35 years of work with petrochemical processes, he has been intimately involved with all the thermochemical processes integral to the Cascadia refinery: syngas generation; Fischer-Tropsch synthesis; and catalytic upgrading of FT liquids into jet, diesel, and lube base oils. His process models are used as the basis for FEL2 and FEL3 evaluations.

Gerald Elliott, Principal Engineer Mr. Elliott is recognized as a leading expert in energy project development. His company, International Applied Engineering, has been retained fo fill the role of developer's engineer. IAE has been serving as engineer of record for environmentally friendly technologies for more than 25 years. It has been tasked with providing a preliminary cost and feasibility analysis, and will be actively supporting Cascadia's negotiations with EPC's, vendors and contractors.

David Busse, Financial Adviser Mr. Busse has over 40 years' experience in real estate and corporate investments and investment banking. Before opening his own financial consulting business, he worked as a Systems Engineer at IBM and providing financial services at various firms on Wall Street and in Arizona. Currently he is bringing innovative financing packages to large renewable energy and multi-use projects. David has degrees in Chemistry and Finance from Harvard University.

Cascadia Bioenergy LLC (“CBE”) is a development company of USA BioEnergy of Scottsdale, Arizona. As the holding company USA BioEnergy oversees the project development, provides management, project funding, and oversight of the development. Currently, the company is developing Projects in the following states: Oregon, Arizona and Arkansas.

USA BioEnergy LLC (USABE) is a Multidisciplinary Industry 4.0 Solutions Development and Portfolio Management Group Specializing in Renewable Energy, Digital Infrastructure, and Intelligent Assets Management. USABE's mission is to develop and support sustainability initiatives, in accordance with the Paris Climate Agreement, to mitigate the negative effects of manmade greenhouse gases and Climate Change.

USABE will develop Digitally Enhanced and Intelligent Thermochemical Process plants capable of converting any biological carbon-containing feedstock into liquid transportation fuels. USABE is a vertically integrated sustainable solutions provider which has developed a proprietary Industry 4.0 Architecture for the Digital Bioeconomy.

USABE is the world's first fully integrated Commercial Developer offering complete and comprehensive Industry 4.0 Solutions within the Global Advanced Renewables Energy Sector.

USABE's Proprietary “Digital Ecosystem” Architecture Represents a paradigm shift in Global Market Trends through the deployment of Digital Frameworks for Sustainable Industrial Applications. CBE will utilize USABE’s “Digital Ecosystem" which is comprised of Enterprise Level Information Technology (APM, PLM, ERP), Edge Computing, Cloud based Analytics, Machine Learning, Virtual Training, and Augmented Reality Maintenance Protocols to Optimize Safety and Performance.

THANK YOU! DISCUSSION AND Q&A