1: Goal Statement

Goal: Successfully construct and operate a 15 million gallon per year cellulosic jet and diesel biorefinery in Lakeview, OR

Relevance: First commercial cellulosic jet & diesel project in the world
1: Project Overview
1: Project Overview

**Project and Site**
- Advanced biofuels production facility converting woody biomass into renewable drop-in jet, diesel, and gasoline blendstock fuels
  - Convert waste woody biomass into \( \sim 15.1 \text{mm gallons/year} \) of renewable cellulosic fuels

**Feedstock**
- 70% of annual feedstock requirement under long term contract

**Offtake**
- **Jet Fuel**: 100% of jet fuel to be sold to FedEx and Southwest

**EPC**
- EPC Contract with IR1 Group LLC

**Economics**
- $200+ million construction
- 500+ construction jobs
- 31+ direct manufacturing jobs
- 120+ feedstock processing & transport jobs
2 – Management Team (Approach)

- Small, lean management team
- Flat structure
- Lean on trusted, experienced suppliers
2 – Project Development (Approach)

Credit: Southwest Airlines, Rollin King & Herb Kelleher, 1966, St. Anthony Hotel, San Antonio, TX
2 – Project Development (Approach)

Project Strategy

Feedstock Supply and Product Offtake Agreements:
- Lock in volume and price with fixed or indexed long term supply agreements
- Fixed or indexed price offtake agreements for plant output
- Avoid the historic pitfalls of the biofuels industry

Minimize Technology Risk:
- Use of proven technology
- Flexible feedstock technology maximizes opportunities
2 – Project Development (Approach)

60,000 acre Watson Creek Fire
Paisley, OR 2018

Klamath Falls News: Trees torching on the Watson Creek Fire near Paisley, Oregon. (Inciweb)
2 – Project Development (Approach)

US Annual Average Wildfire Acres & Federal Suppression Costs ($, inflation adjusted)

- 1985 - 1994
- 1995 - 2004
- 2005 - 2014
- 2015 - 2017

Acres

Cost ($)

2017: 10 million acres, $2.9 Billion
2018: 7.7 million acres through 10/4

National Interagency Fire Center
2 – Technical Approach

• Develop platform of next generation biorefineries, utilizing waste woody biomass to produce renewable jet and diesel fuels

• Help address rapidly growing problem of wildfire in Western U.S., make renewable heavy transport fuels

• Thermocatalytic conversion from the beginning
2 – Technical Approach

Biomass Conversion Process

- Woody biomass is converted into syngas via gasification
  - Licensed technology provided by TCG
- Syngas fed to a syngas clean-up and conditioning system for removal of contaminants
  - Process designed by Fluor
- Upgrading of the FT Products into the Project’s jet, diesel, and gasoline blendstock fuel products through hydrocracking and fractionation
  - Licensed technology provided by Haldor Topsoe

- Waste woody biomass sourced from a surrounding 125-mile feedstock draw radius
- Slash and pre-commercial thinnings
- Front end handling system designed by Wolf Material Handling

- Syngas carbon monoxide (“CO”) and hydrogen (“H₂”) react with the catalyst to form Fischer-Tropsch waxes and liquids
  - Licensed technology provided by Velocys and EFT

- Plan to ship all liquid products by rail
  - Jet fuel to be shipped to customers FedEx and Southwest Airlines at Oakland Airport
  - Rail service by Goose Lake Railway, which connects to Union Pacific Railroad in California
3 – Construction Progress

• Greenfield construction project, ~18 months from start of work engineering through mechanical completion

• IR1 Group LLC (RRB’s parent) is the Engineering, Procurement and Construction (EPC) Contractor

Challenges

• Manage engineering, fabrication and construction activities across about a dozen engineering firms, technology providers and construction contractors

• Deliver project on time and on budget
3 – Construction Progress (18 Jul 2018)
View of field fabricated tank construction, 29Jan2019, 3:45pm, facing W
4 – Relevance

“The creation of a robust, next-generation domestic bioenergy industry is one of the important pathways for providing Americans with sustainable, renewable energy alternatives.” – U.S. DOE BETO
“Scientific consensus: Earth's climate is warming”
4 – Relevance

- Transportation sector already major source of CO2 emissions (27%)
- Growing population and standard of living will increase jet & diesel fuel use:
  - 30% more diesel fuel by 2040
  - 50% more jet fuel by 2040

Credit: International Energy Agency, World Energy Outlook 2016; Exxon Mobil 2017 Outlook; U.S. Environmental Protection Agency
5 – Future Work

• Complete construction of Lakeview by about the end of 2019

• Successfully operate Lakeview

• Build a portfolio of similar biorefineries to expand supply of renewable jet & diesel fuels and help reduce the impact of wildfire
5 – Future Work

Production Potential, by county

- >25M gal/yr
- 10-25M gal/yr
- 5-10M gal/yr
- 1-5M gal/yr

Lakeview site

Credit: USDA BioSys database,
Summary

• Global climate change is both the biggest challenge of our generation and the biggest brass ring

• We are building a portfolio of biorefineries to produce low carbon, renewable jet and diesel fuels and reduce the impact of wildfire

Winston Churchill, 1940: “Victory, no matter how long and hard the road may be.”

Photo Credit: Yousuf Karsh, 1941.