UNDERUTILIZED *PROTEINACEOUS* BIOMASS FEEDSTOCKS CAN INCREASE PRODUCTION CAPACITY BY 400% TO FULFILL THE SAF GRAND CHALLENGE

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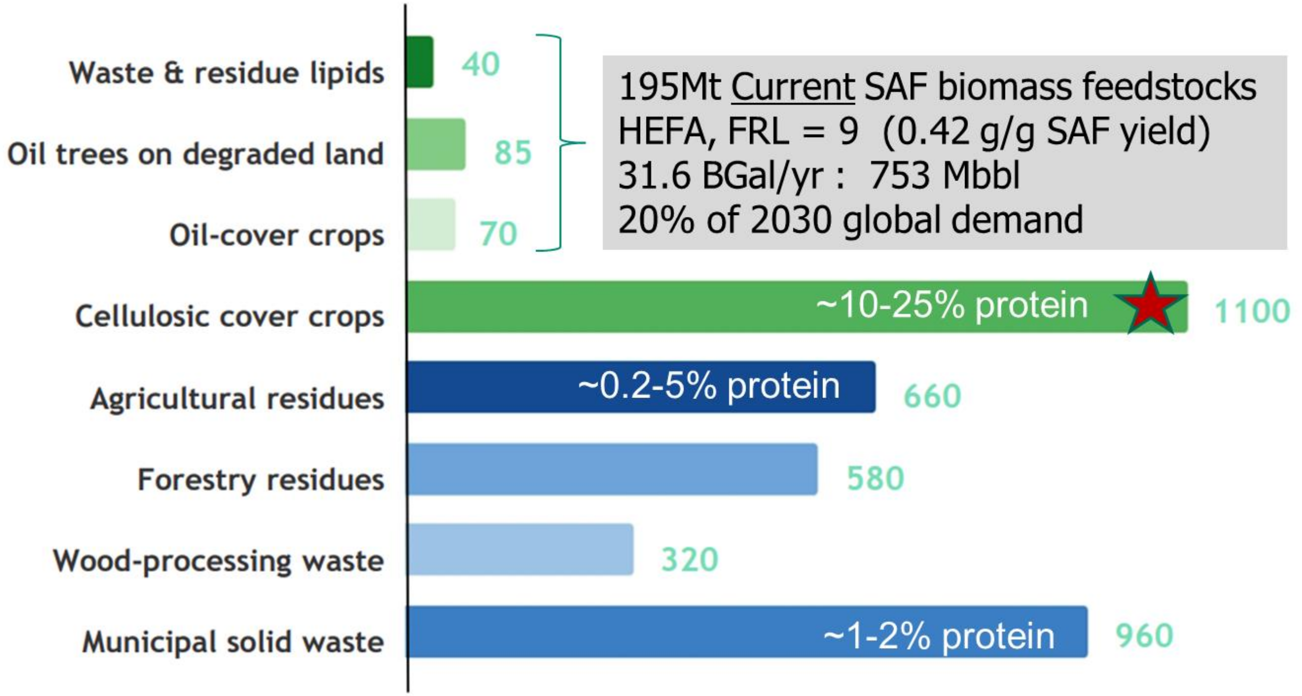
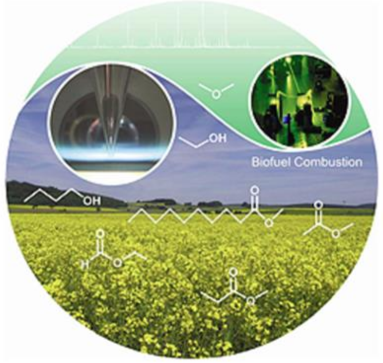
2030 Practical Feedstock Availability (Mt)



195Mt Current SAF biomass feedstocks
HEFA, FRL = 9 (0.42 g/g SAF yield)
31.6 BGal/yr : 753 Mbbl
20% of 2030 global demand



Technologies are required that can maximize yield and value from various types of proteinaceous biomass

3815Mt Total biomass resource
FRL < 7 (0.256 g/g SAF yield)
158.3 BGal/yr : 3.77 Bbbl
100% of 2030 global demand

World Economic Forum & McKinsey & Company, 2020
Jorgensen et al *Grass Forage Sci* 2022
Thers & Eriksen *J. Sci. Food Agric.* 2022

Current regulatory limits for fusel alcohol co-products of bioethanol could support 4% of US SAF demand (18M bbl).

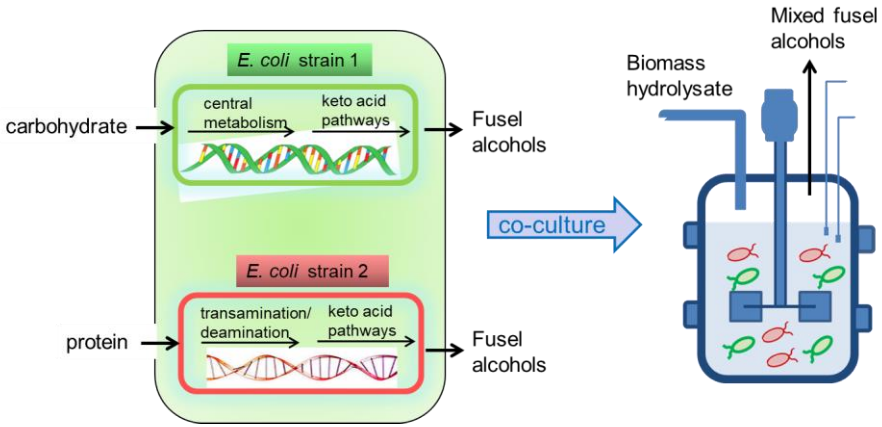
By providing the capability to obtain 26% w/w conversion yield from cover crops, we can provide up to 38% of US SAF demand.

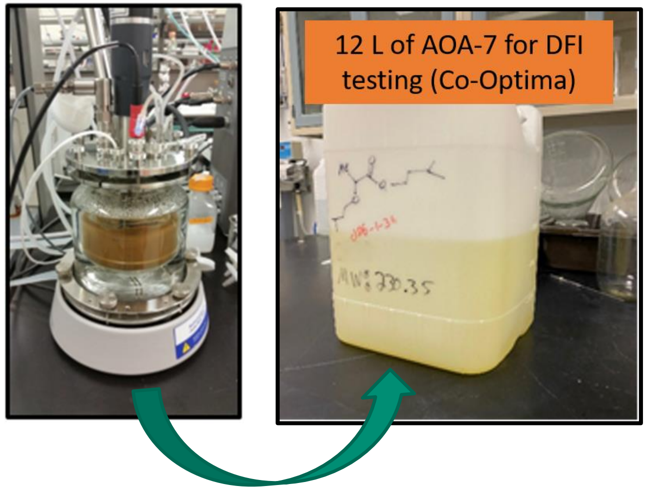
SANDIA'S HAS DEVELOPED FUSEL ALCOHOL BIOPROCESSING TECHNOLOGY FOR PROTEINACEOUS BIOMASS

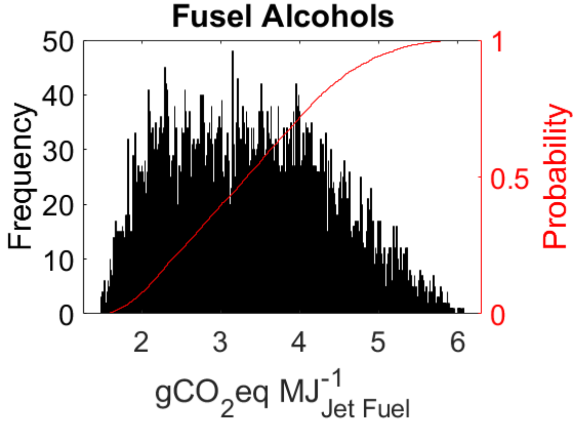
Consortium Biocatalysis: Provides tunability for [protein]:[carbohydrate]:[lignin]

Proteinaceous cellulosic cover crop biomass

Oilseed cake







Fusel alcohol AtJ can achieve life cycle ***CO_2eq emissions at or below 1.9 $gCO_2eq\ MJ^{-1}$$_{\textit{Fusel alcohol}}$*** through process optimization, e.g., Lower H_2 consumption at 0.08 $KgH_2\ Gal_{\text{Jet fuel}}$

Best cases for minimizing CO_2 emissions correspond to reduced H_2 requirement

Other authors

Conventional Jet fuel from crude oil: **11.1 gCO2 MJ^{-1}**

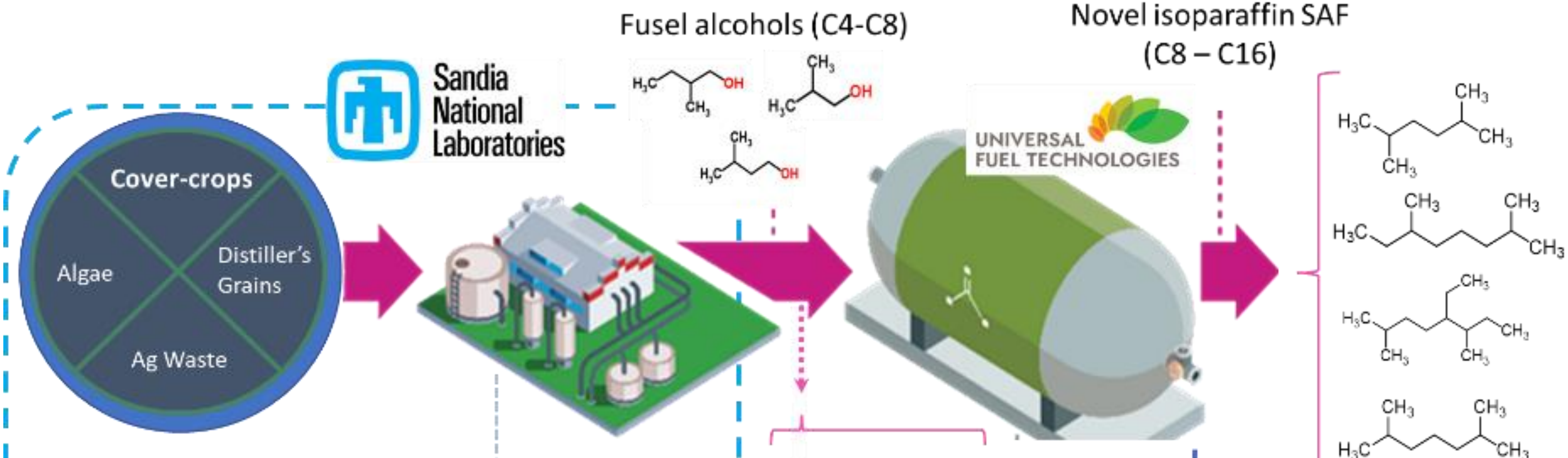
Corn oil-based renewable Jet fuel: **22.6 gCO2 MJ^{-1}**

Fischer-Tropsch Jet fuel from Biomass: **4.5 gCO2 MJ^{-1}**

Wu et al *Algal Res* 2016, 2107
Liu et al *Microbial Cell Fact* 2017
DeRose et al *ES&T* 2019

Liu et al *Biores Tech* 2019
Monroe et al *Fuel* 2020
Quiroz et al *Sust Energ Fuels* 2022
Mhatre et al *Front Bioeng Biotechnol* 2022

PROTEINACEOUS BIOMASS BIOPROCESSING PROVIDES MEANS TO MAXIMIZE VALUE AND MINIMIZE HETEROATOM AND METALS CONTAMINANTS IN SAF



Whole biomass - dilute acid pretreatment and saccharification

***E. coli* & *C. glutamicum* -** bioconversion of C5/C6 sugars, amino acids, and lignin monomers into fusel alcohols

Residual solids- high value amino acids, major N/P nutrients, and organic carbon as recalcitrant lignin

FuselAtJ/Flexifuel – Mixed alcohol coupling & hydrogenation for SAF. >50% reduced energy req. than ethanol, predicted