GranBio
enabling NET ZERO™

Enabling NET ZERO
Meeting the Global Demand for Sustainable Aviation Fuel & Low Carbon Bioproducts

USDA U.S. DEPARTMENT OF AGRICULTURE

USDA'S 100TH ANNUAL
AGRICULTURAL OUTLOOK FORUM
CULTIVATING THE FUTURE

HYBRID EVENT · February 15-16, 2024 · Crystal City Gateway Marriott, Arlington VA

FOREST SERVICE U S DEPARTMENT OF AGRICULTURE

Forest Products Laboratory

About GranBio

We use residual biomass as feedstock to capture CO_2 from the atmosphere and convert it into low carbon 2G sugar intermediates, biofuels, biochemicals and advanced bio-materials to reduce fossil products dependence and reverse climate change

GranBio is a cleantech leader and pioneer company with over 200 global granted patents and over 150 patents pending*. The Company builds and operates biorefineries and licenses its proprietary renewable technologies to enable customers to reach their decarbonization and Net Zero emission objectives with the whole green barrel approach.

GranBio also enables production, storage and treatment of various lignocellulosic biomass types as feedstock to biorefineries at large scale.

Legal US Domicile in Delaware

Pilot plant and R&D Center in Thomaston, Georgia

2G ethanol plant in Alagoas
RSB Certified for low carbon
Biomass expertise export to the world

Unique 2G ethanol & lignin dedicated operating plant

Owner of the two most competitive biomass cracker technologies

+50 people involved in R&D, JDA's, and strategic alliances

+15 commercial collaborations in nanocellulose to create NetZero renewable

Global presence. plants and research facilities in the United States and Brazil

KEY PARTNERS

U.S. DEPARTMENT OF ENERGY

Honeywell UOP

nuSEED

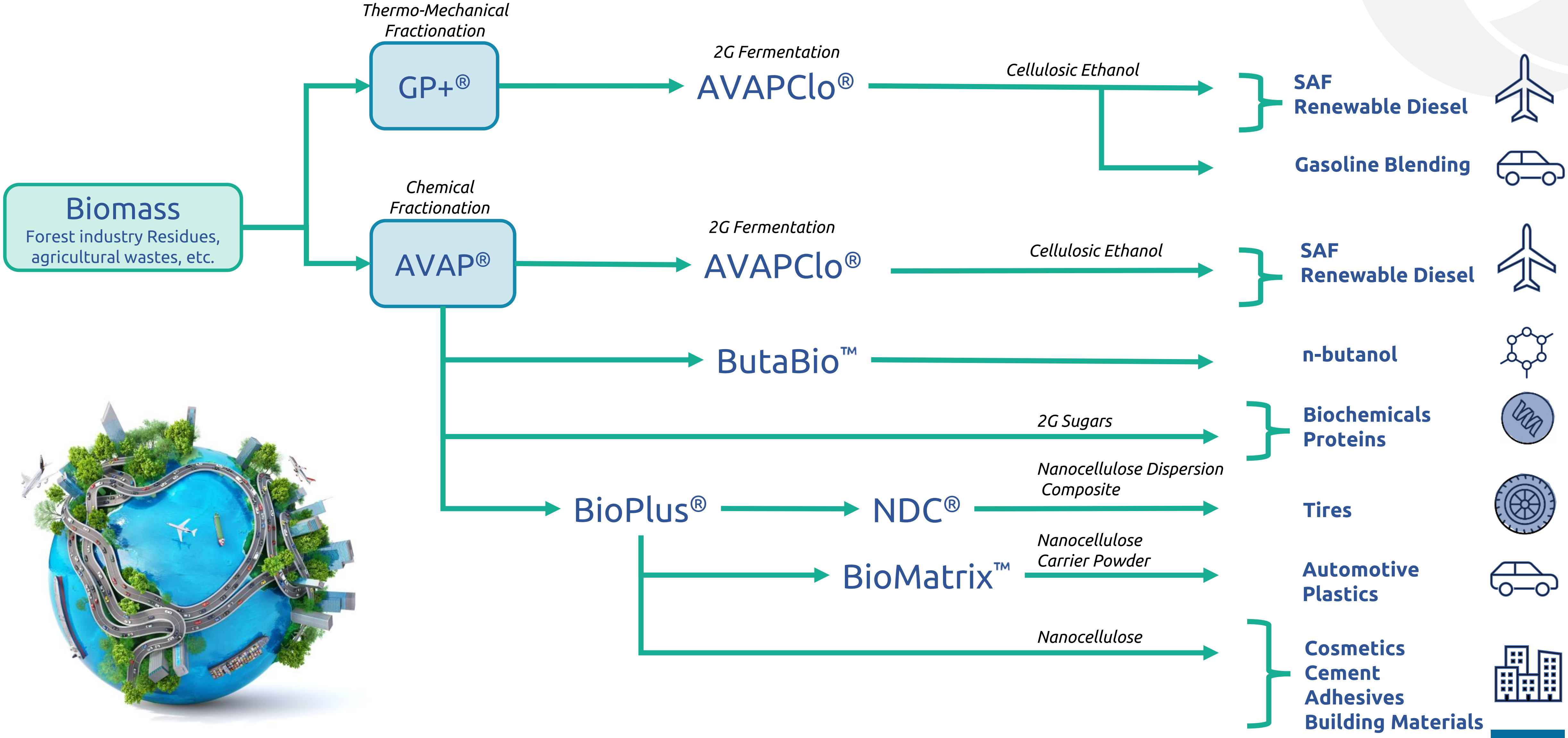
BIRLA CARBON

USDA

* Valuation according to Investment Value Criteria: USD1.7 Billion 2021 by PeakValue IP

Renewable Technologies Portfolio

GranBio has developed one of the world's largest portfolio of renewable technologies to address the world's hardest to abate sectors.



Our Current Operations in Brazil and USA

Our production and R&D sites support our expansion plan.

BioFlex I – GranBio's Cellulosic Ethanol Plant in Alagoas, Brazil

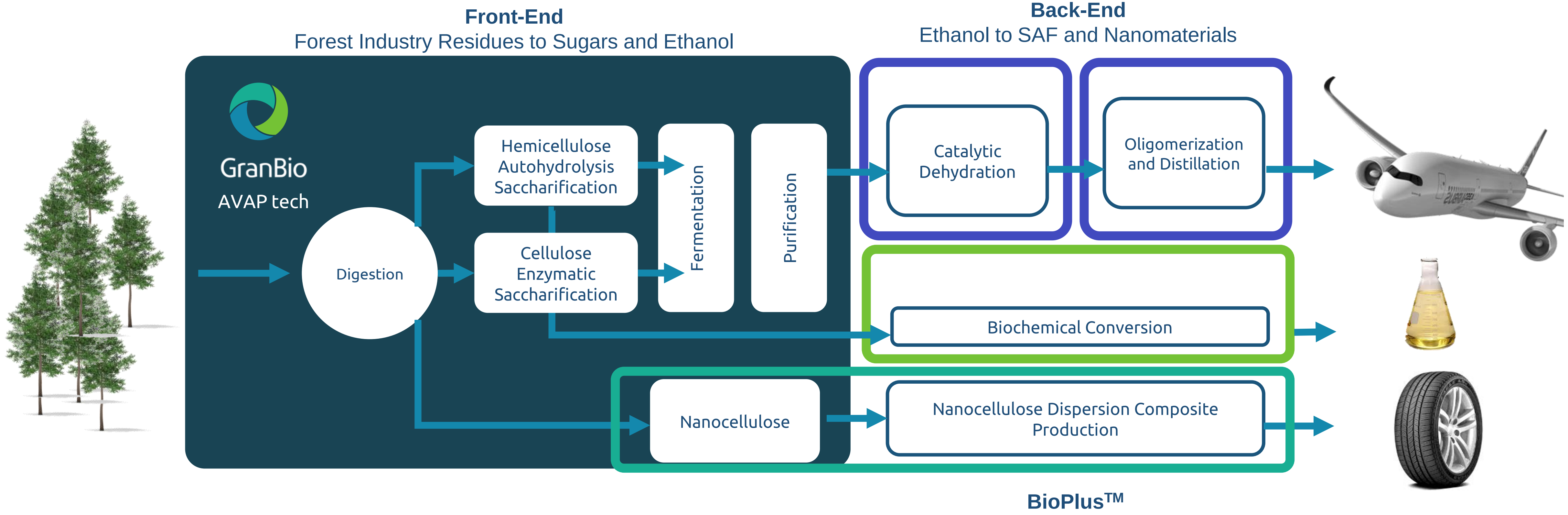
Thomaston Integrated Pilot and R&D center in Georgia, USA

AVAP^{TM}

GranBio's widely patented AVAP technology utilizes the "Whole-Barrel" biorefinery approach, addressing different markets from different biomass components.

The AVAP Technology enables a profitable biorefinery in part because it produces a series of valuable products including:

- Low-volume, high-value nanocellulose products (e.g., NDC) together with high-volume commodity liquid fuels at reasonable scale and attractive cost levels
- Biochemicals from 2G sugars



Feedstock Flexibility

Wide-variety of abundant, low-cost feedstock.

Abundant Biomass Feedstock Utilization

- More than 17 different types of biomass have been extensively processed and proven at the AVAP integrated Pilot Plant in Thomaston R&D Center during the last 12 years
- Allows utilization of the wide variety of cellulosic biomass sources available throughout the United State (1-billion tons per DOE)
- Through a separate DOE-funded project, AVAPCO has shown that residual low-cost, woody-biomass alternatives can significantly reduce the price of SAF by up to 30%

Advantages of Woody Biomass

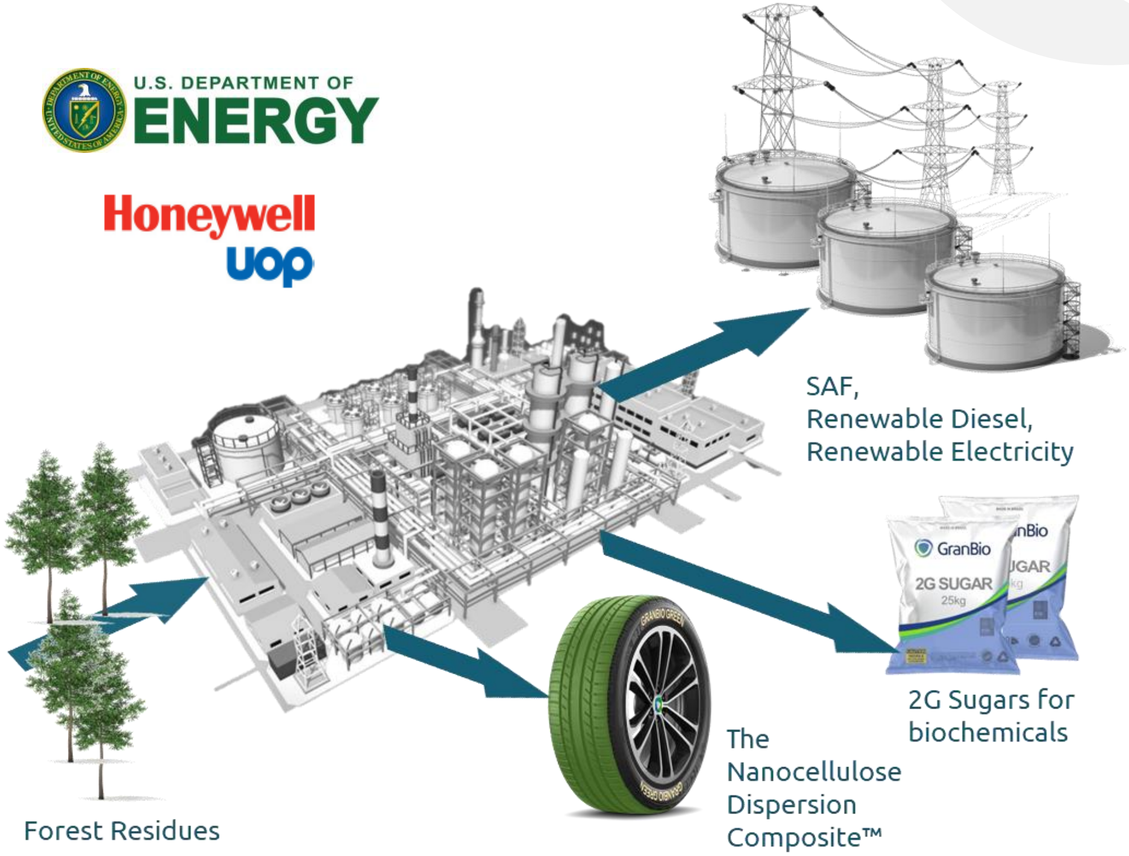
- Established harvesting & delivery industry and infrastructure
- High density provides low transportation cost
- Low sand and dirt content
- Year-round harvesting
- Dense structure & mechanical stability for feeding process equipment

Enabling Net Zero

Key Project Highlights.

1. **Capacity**
   ~2Mmgal per year of SAF and renewable diesel and 6,600 tons/year of NDC(1)
2. **Start-Up Date** expected Q3 2026
3. **Feedstock**
   Forest industry residues with agricultural residues campaign
4. **GHG Reduction Potential**
   Carbon neutral with potential for carbon negative SAF, depending on final facility configuration(2)
5. **Location**
   Both shuttered and operating pulp and paper mill sites within the US are under consideration
6. **AVAP Technology**
   Globally patented technology with third-party determination of Freedom-to-Operate. Previously developed and demonstrated at integrated pilot scale
7. **ETJ partnership with UOP Honeywell**
   Top-tier partner with "make-it-right" process guarantee
8. **100% Replacement SAF Production**
   SAF with aromatics will be produced for engine testing to support ASTM approval of ATJ SKA#2 full replacement fuel pathway
9. **DOE grant funding**
   US$ 80m under a cost-sharing arrangement

ENZ Project Schematic



1. A small NDC production campaign of 750 tons will be run during 16-month DOE demo period
2. LCA for various facility configurations and feedstock performed by Michigan Tech

ENZ Project Schedule

2023 — **Phase 1** — **2024** — **Phase 2** — **2026** — **Phase 3** — **2027**

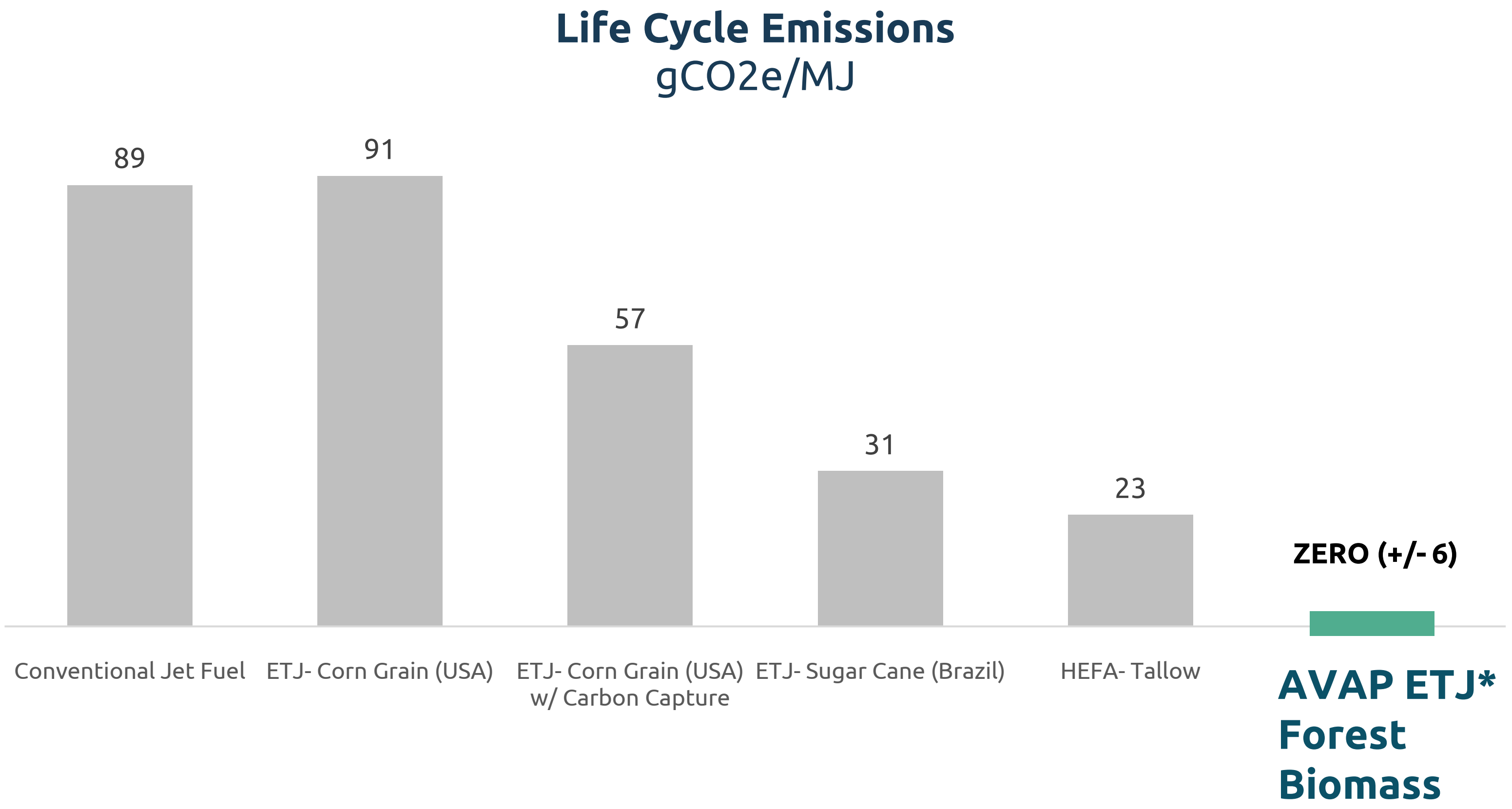
Development
Finalize cost share financing
Finalize off-take contracts
Hire staff

Execution
Permitting
Detailed Engineering
Procurement
Construction

Operation
Commissioning
Start-up
Ramp-Up
Operation at steady state
Product Sales

Third-Party Life Cycle Analysis: Net Zero AVAP SAF

Current LCA modeling by Michigan Tech shows AVAP-enabled SAF from forest biomass is capable of NET ZERO and carbon negative emissions, even at ENZ demo scale.



**Critical parameters include heat integration, forest biomass type, and excess electricity to grid from combined cycle biomass power production.*

Sources (1): "Life Cycle Greenhouse Gas Emissions and Costs of Production of Diesel and Jet Fuel from Municipal Solid Waste", ENERGINET; Energy Insights' Global Energy Perspective; IVL report "Investment Cost Estimates for Gasification-based Biofuel Production Systems" McKinsey: "Clean Skies for Tomorrow: Sustainable Aviation Fuels as a Pathway to Net-Zero Aviation";(2) CORISA Default Life Cycle Emissions Values for CORSIA Eligible Fuels, ICAO, June 2022. (3) Sustainable Aviation Fuels from Low Carbon Ethanol, Jim Spaeth, BETO DOE, October 2021

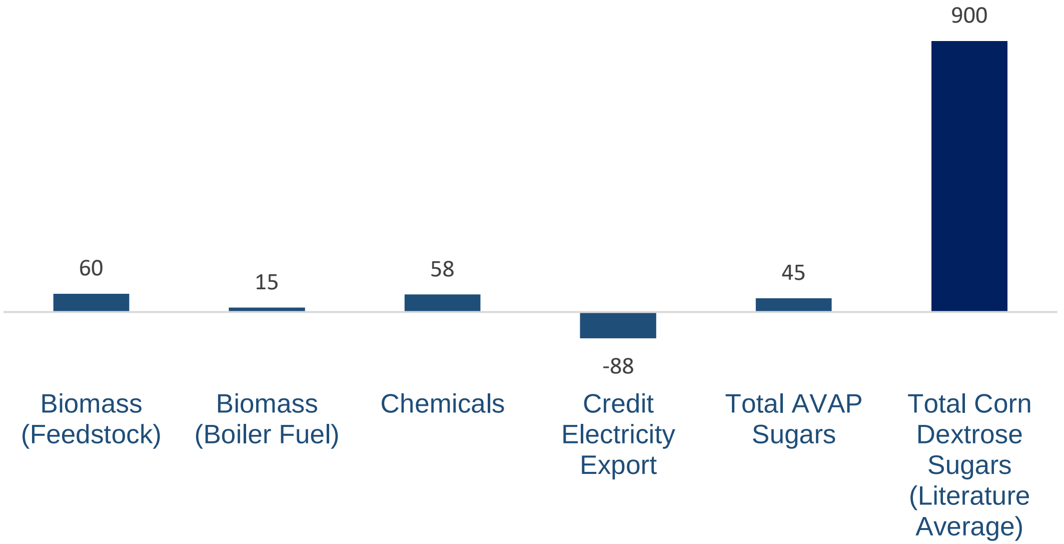
Low Carbon 2G Sugars for Biochemical Conversion

GranBio's 2G sugars offers significant advantages over first generation sugars in terms of carbon foot-print (that will enable a market premium) and production cost (resulting from low-cost residual biomass).

AVAP 2G Sugars "Cradle-to-Gate" Carbon Intensity

- The GHG emissions (g CO2eq/kg sugar) from AVAP 2G sugar production using forest residuals are 95% less than corn dextrose sugars[(1)]

Global Warming Potential (g CO_{2eq} per kg sugar)

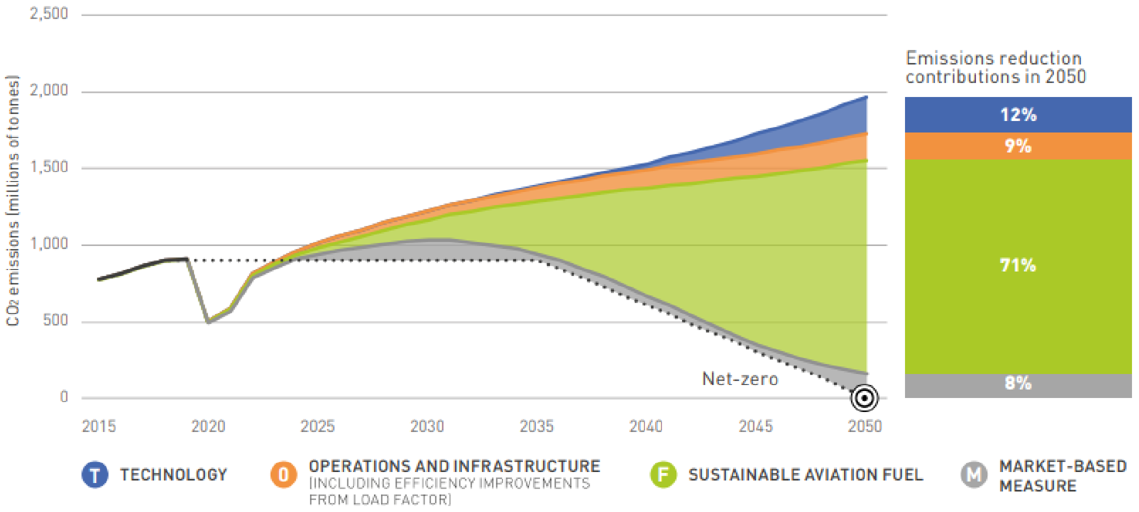


Notes: (1) LCA performed by Michigan Tech;

SAF Market Drivers

Market timing is unique: worldwide regulatory mandates & consumers' decarbonization objections are driving a strong SAF demand of 450 million tons per year by 2050.

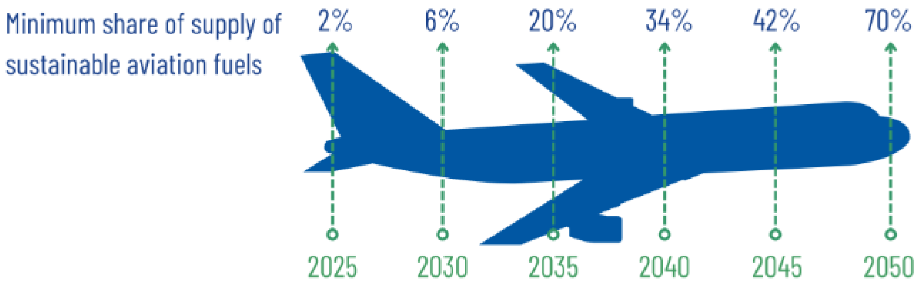
Global Aviation long-term goal to Net Zero CO2 emissions



Global SAF Mandates

2022 US SAF Grand Challenge Goals

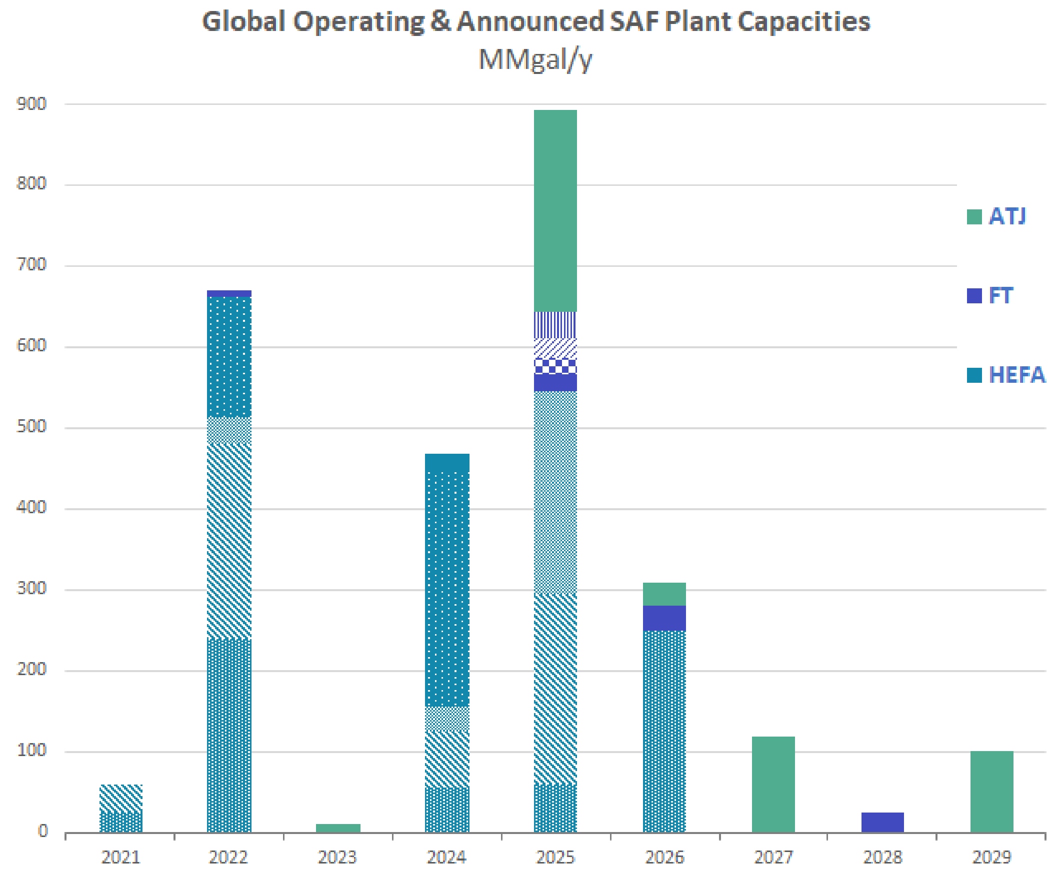
2023 EU SAF Mandate (ReFuelEU)

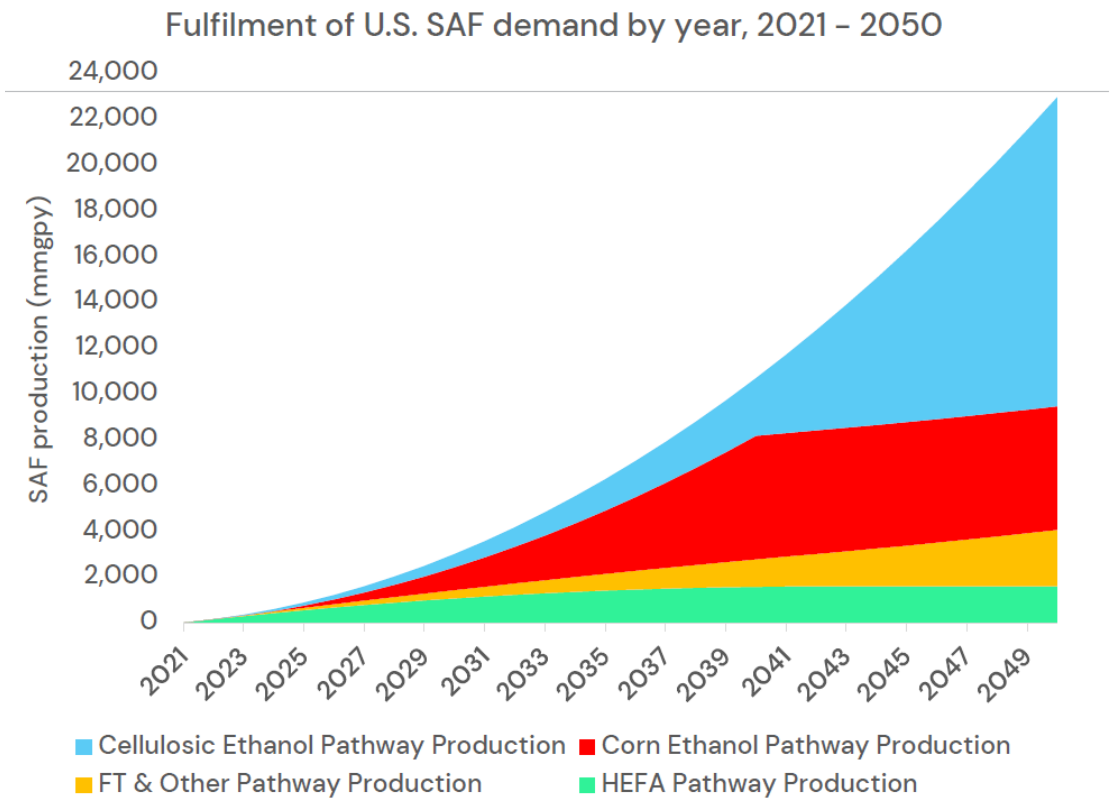


Sources: https://www.whitehouse.gov/briefing-room/statements-releases/2021/09/09/fact-sheet-biden-administration-advances-the-future-of-sustainable-fuels-in-american-aviation/; https://www.consilium.europa.eu/en/infographics/fit-for-55-refueleu-and-fueleu/; World Economic Forum

Several SAF technologies are competing to be the key pathway

SAF can be obtained through different production methods and associated technologies. Currently, HEFA (refining oils into SAF through hydrogen) is leading the pack – but cannot meet future demand needs due to feedstock limitations.





Sources: Commercial Aviation Alternative Fuels Initiative (CAAFI). Business press. ICF

Increasing Shift from Petrochemicals to Biochemicals

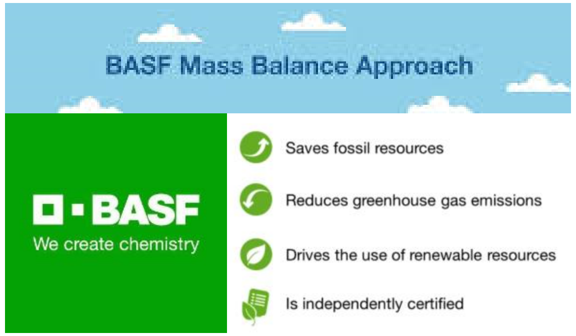
Today 95% of all manufactured goods are made from fossil-fuel derived petrochemicals. Demand for more sustainable chemical products is increasing as product manufacturers are faced with environmental and societal pressures.

Petrochemical Industry Trends

- The chemicals industry represents 4% of global CO_2 emissions and is also the largest industrial consumer of hydrocarbons worldwide, utilizing them as process feedstock and for process energy
- Many multi-national chemical companies have stated commitments to achieve NET ZERO by 2050

Biochemicals Solutions

- Biochemicals produced from bio-based feedstocks are estimated to replace 43% of petrochemicals by 2050
- New manufacturing approaches based on bio-based feedstocks offer a pathway for a large portion of the chemical system to become a “carbon sink”, absorbing more CO_2 than is produced



GranBio's Proven Biochemicals from AVAP 2G Sugars

AVAP sugars have been converted to a variety of biochemicals with performance equivalent to dextrose.

Ethylene

- Market Size: $140 billion/yr US$; CAGR +6%
- Applications: PE polymers; building block for many downstream chemicals and materials
- Producers: Large oil and chemical companies, using natural gas or naphtha from crude oil

Succinic Acid

- Market Size: $0.5 billion/yr US$; CAGR +7%
- Applications: Chemical building block used in the manufacture of polymers, plasticizers, and pharmaceuticals
- Producers: Global chemical companies, using hydrogenation of maleic anhydride derived from crude oil

Lactic Acid

- Market Size: $4 billion/yr US$; CAGR +9%
- Applications: Polylactide (PLA) polymers, a sustainable and renewable plastic that competes with PET and others
- Producers: Cargill, Corbion, ADM

Butanediol (BDO)

- Market Size: $7 billion/yr US$; CAGR +9%
- Applications: Polytetrahydrofuran and polybutylene terephthalate; performance polymers; engineering plastics
- Producers: BASF and many Asia players, using crude oil; Cargill plant in USA will use corn sugar fermentation to BDO

n-Butanol

- Market Size: $3.5 billion/yr US$; CAGR +5%
- Applications: Solvents; building block for acrylates and methacrylates, coating resins, and butyl carboxylates
- Producers: Fragmented market; conventionally produced from hydroformylation/hydrogenation of propylene

Source: GranBio (internal)

BioPlus Nanocellulose for Tires

GranBio has developed and scaled a drop-in nanocellulose product (NDC™) that reduces the fuel consumption and increases the renewable content of tires.

BioPlus Nanocellulose Advantages

- Replacement for reinforcing carbon black and silica currently used in tire rubber compounds which have sustainability, rolling resistance and processing challenges
- Low rolling resistance / high fuel economy
- Renewable: most abundant polymer in nature
- Patented lignin-coated form is a UV absorber & anti-oxidant to displace petrochemical based products used for these functionalities in tires
- High processability
- Low GHG emissions associated with production

Tire rolling resistance accounts for up to

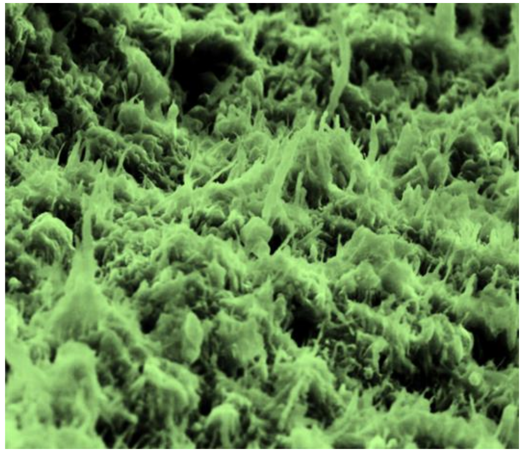
30%

of a vehicle's fuel consumption and CO2 emissions

Nanocellulose Dispersion Composite™ (NDC) Advantages

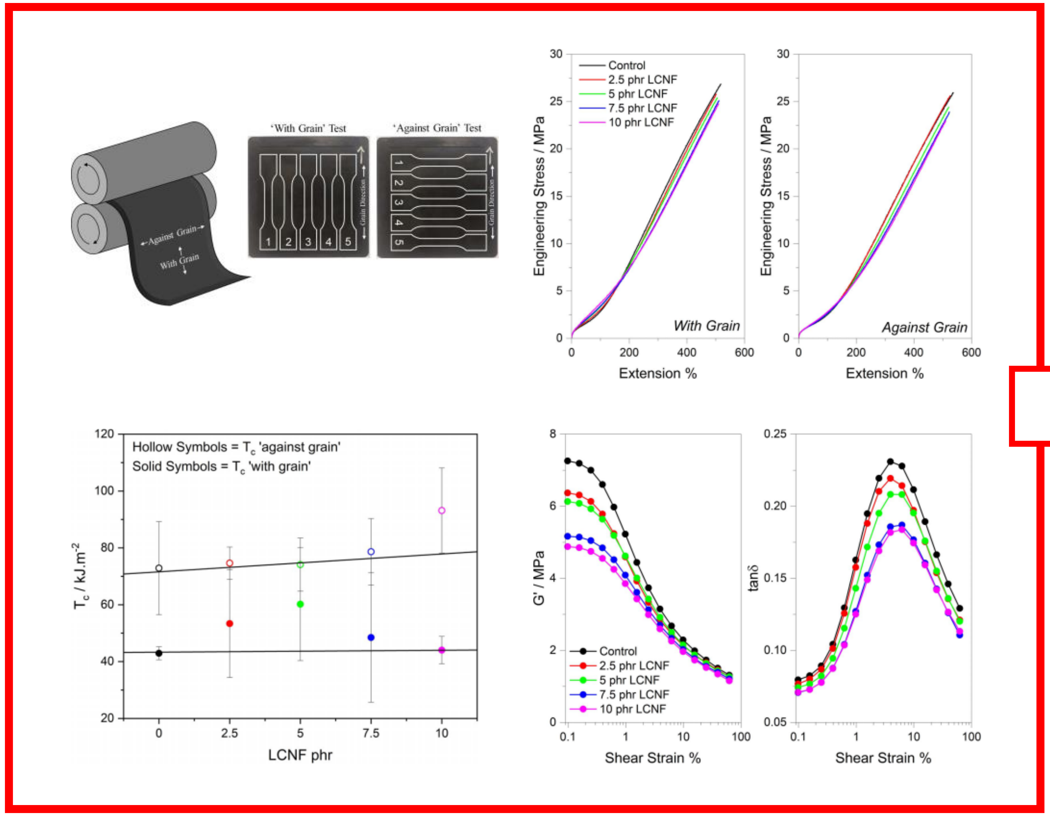
This solid rubber masterbatch product allow tire manufacturers to easily dose precise, highly dispersed nanocellulose into rubber compounds during manufacturing.

- Drop-In
- No compounding process or equipment modification required
- Dust-free handling of nanomaterials
- Easily cut, weighed, and dosed
- Highly concentrated pre-dispersion of discrete nanoparticles / prevents agglomeration that can deteriorate performance



Example Performance in Rubber

Performance in truck tire formulation with 20% NC in place of carbon black:



Property	Change with 20% NC
Dispersion Quality	Maintained
Fuel Economy	+20%
Stiffness	Maintained
Strength	Maintained
Abrasion Resistance	Maintained
Tear Resistance	Maintained / Slightly improved
Light weighting	~1%

For more details: Tunnicliffe et al., *Reinforcement of Rubber by Carbon Black and lignin-Coated Nanocellulose Fibrils*, Rubber Chem. Technol., (2020), 93(4): 633-651

NDC Development Trajectory

2015

BioPlus Nanocellulose Pilot Line Start-Up

bioplus
Advanced materials. Naturally.

2016

Nanocellulose Sampling to Birla Carbon

2017

JDA Signed between GranBio & Birla Carbon

$7.3M grant for SAF & Nanocellulose Masterbatch Pilot from DOE

2018

NDC Laboratry Development

2019

2020

NDC Product Launch at Tire Tech for Customer Evaluation

Batch Pilot Trials

2021

Continuous Pilot Trials

P3Nano Scale-Up Grant

U.S. Endowment for Forestry and Communities

2022

USDA Wood Innovations TEA Grant

2023

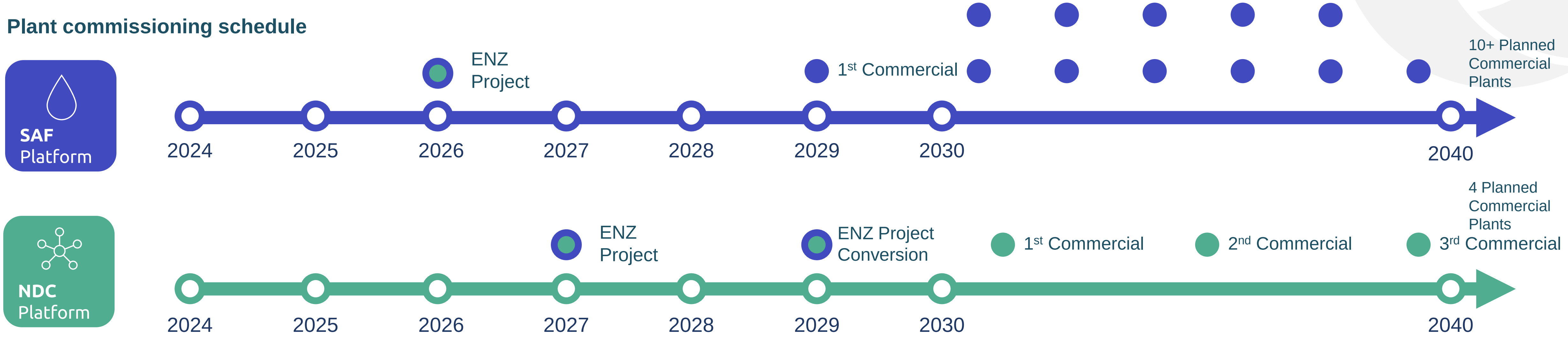
$80 million grant for SAF & NDC Demo Plant

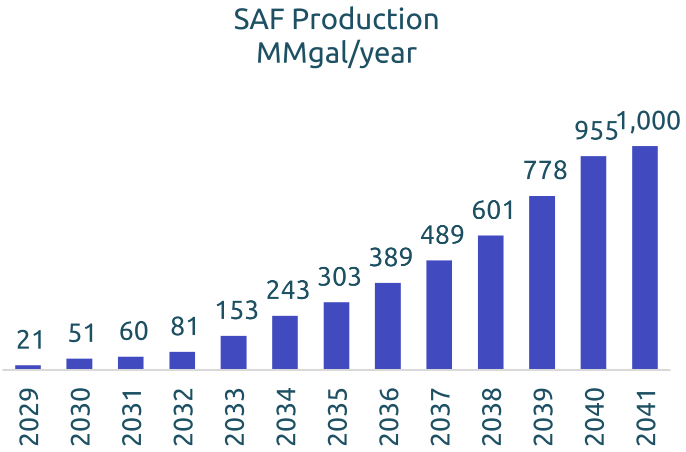
2 NDC patents granted and 26 pending globally

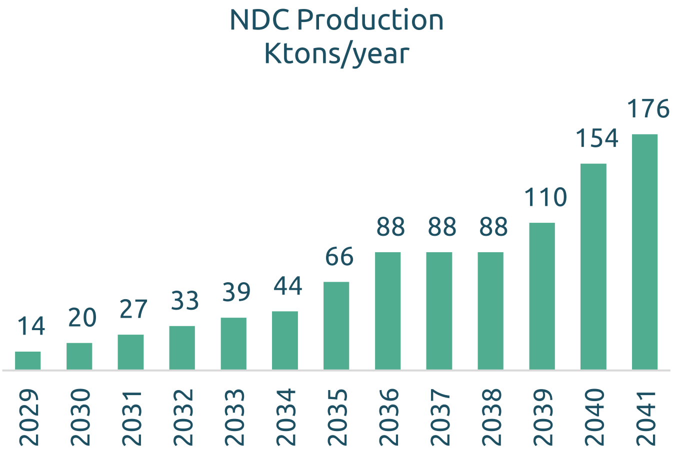
Commercial Rollout Schedule & Targets

The construction of the first commercial scale plant will lead to a broader rollout. The business plan envisions 10+ plants to be built over the next 15 years.

Plant commissioning schedule







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