



# The Confluence of Biomass Supply Systems for Sustainable Aviation Fuel, Biomanufacturing, and Renewable Natural Gas : USDA Update

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ASCENT Meeting  
Alexandria, VA October 24, 2023



# Topics

- Our shared enterprises:
  - Sustainable Aviation Fuel Grand Challenge
    - Update on SAF Grand Challenge Roadmap Implementation
  - Executive Order on Biotechnology and Biomanufacturing
    - Biomass Feedstock Supply Chain Plan
  - Cover Crops
    - Harvested winter oilseeds (e.g., pennycress, carinata)
    - Renewable Natural Gas
      - Codigestion of manure and harvested cover crops
    - Dramatically increase the adoption of cover crops
      - Benefits
      - Challenges
      - Opportunities





# Sustainable Aviation Fuel Grand Challenge Roadmap: Focus on Feedstocks and Supply Chains

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Ag – SAF Summit  
St. Louis, MO, September 7,  
2023



# Ag-SAF Summit, St. Louis, MO, September 7, 2023

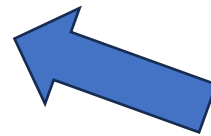
- **Feedstock Producers/Seed Companies\***

- Algae Biomass Organization
- American Soybean Association
- Bayer
- CoverCress Inc.
- Iowa Corn Growers Association
- Illinois Corn Growers and Farm Bureau
- MI, MO, OH Corn Growers Associations
- IN and MN Soybean Associations
- KS Grain Sorghum Commission
- Minnesota Soybean R&PC
- National Association of Wheat Growers
- National Corn Growers Association
- National Wheat Growers Association
- Nuseed
- Partners for Production Ag
- Sustainable Oils

- **Feedstock Processors/Fuel Producers/End Users**

- Airlines for America
- Archer Daniels Midland
- Bunge
- Chevron
- Gevo
- Growth Energy
- LanzaJet
- National Association of State Departments of Agriculture
- National Corn to Ethanol Research Center
- Pacific Northwest National Lab
- ProExporter Network
- Renewable Fuels Association
- Smith-Bucklin
- Southwest Airlines

\* Represent 250 Million Acres of US Crop Production



# SAF GC Roadmap – Implementation

## Six Action Areas

### 1. Feedstock Innovation

Inventory and Gap Analysis Completed

Biomass Supply Chain Plan Completed (in review, target October 2023)

### 2. Conversion Technology Innovation

Inventory and Gap Analysis Completed

### 3. Building Supply Chains

RFI Developed (will be released soon). Inventory completed.

### 4. Policy & Valuation Analysis

LCA Team formed. Working with EPA and Treasury on sustainability thresholds and methodology for IRA tax incentives.

### 5. Enabling End Use

Fast-SAF (FAA) Infrastructure NOFO Completed (Release soon)

### 6. Communicating Progress & Building Support

Web Page up and running [Sustainable Aviation Fuel Interagency Working Group | Biomass Research & Development \(biomassboard.gov\)](https://www.biomassboard.gov)

Webinars

Progress Update (in preparation)



# Feedstock Innovation and Building Supply Chains

- Key Workstreams under the Feedstock Innovation and Building Supply Chain Action Areas
  - **Understanding feedstock resource** markets and availability
  - Increasing production of **purpose-grown biomass** resources and collection of **wastes and residuals**
  - Improving feedstock **supply logistics**
  - Increasing the reliability of **feedstock handling systems**
  - **Improving sustainability** (economic, environmental, and social) of biomass and waste supply systems
  - **Building biomass supply systems** that provide ecosystem services and enhance food and feed crop production
  - Building supply chains through growing and supporting **regional stakeholder coalitions** through outreach, extensions, and education
  - **Modeling** biomass feedstock **supply chains**
  - Designing and implementing **supply chain demonstrations**

# To Get to 3 Billion Gallons Annual US Production by 2030

- **Consistent SAF policy support**
- 3-billion gallons
  - Expand production of low CI lipid feedstock
    - Focus on cover crop adoption
    - Lower CI canola and soybean?
  - Explore means for ethanol CI reduction (e.g., RNG, CCS) for ATJ
- By 2030
  - Leverage existing/planned RD capacity
- Infrastructure Needed
  - Required infrastructure at airports to accept and blend SAF
  - Given the 1-6 year project timeline, this work needs to start now
- Looking forward
  - Efficient technologies for cellulosic feedstock beyond pioneer plant

# EO 14081 Advancing Biotechnology and Biomanufacturing Innovation for a Sustainable, Safe, and Secure American Bioeconomy

- A Plan to Enable the Bioeconomy in America: Building a Resilient Biomass Supply
  - USDA led plan
  - Currently under administrative review
  - Expected public release December 2023
  - Focus on existing and emerging biomass supply chains
  - Significant overlap with the SAF Grand Challenge Roadmap Feedstock Innovation Action Area
  - Both the EO Plan and the SAF Roadmap place emphasis on “harvested cover crops”
    - New oilseed crops (camelina, carinata, pennycress), annual grasses (e.g., winter rye)
      - Beginning to understand that these crops, while not primary cash crops, can provide ecosystem services and additional farm-gate income and jobs if harvested and processed.
      - Commercial adoption is beginning, but there are many questions and nuance within these emerging portfolios.



# Key Takeaways from the SAF GC Roadmap and the EO Supply Chain Plan Report

- 1) **U.S. biomass supplies are abundant.** The United States is well-positioned to utilize and leverage those resources for a growing range of biofuel and biobased product applications as well as increase available biomass and innovate new uses.
- 2) There are gaps in our knowledge of current and projected future **biomass feedstock availability.**
- 3) There is much to learn about **competing markets** for biomass feedstock and **incentivizing new market creation.**
- 4) Purpose-grown biomass crops need to be produced at scale for the bioeconomy to substitute renewable resources for non-renewables, **but farmers will not risk planting crops without established markets.**
- 5) **Emerging crops, such as camelina, pennycress, and carinata, can increase biomass availability and sustainability of commodity row crop production without increasing land use, as cover crops and through double-cropping.**
- 6) **Woody biomass can provide a large volume of needed biomass, but the economics of forest operation residuals, mill waste, forest health thinnings and wildfire fuel removal need to be better understood and made more cost-effective.**

# Example: Pennycress in Corn-Soybean Rotations

- Integrated Pennycress Research Enabling Farm and Energy Resilience (IPREFER): CoverCress, U Western, IL, U SIL, U MN, ARS
  - High quality oil for fuel, press cake for feed in US (gene-edited crop)
  - Potential for cultivation on millions of acres across Midwest
  - Expected to grow to 3 million acres in 10 years (Missouri, Indiana, Illinois)
  - CoverCress purchased by Bayer (independent subsidiary)
  - Strong commercialization partners
    - Bunge: (crush), meal
    - REG/Chevron: oil for SAF, renewable diesel



# Example: Carinata in Southeastern Rotations

- Southeast Partnership for Advanced Renewables from Carinata (SPARC)  
Nuseed, UFL, MSU, UGA, ARA
  - Excellent oil for SAF/Renewable Diesel
  - Eligible for EPA RINS incentives
  - Non-GMO livestock feed. Huge existing market in the EU.
  - Commercialization partners: ADM (crush) meal, BP: oil for fuels
  - Good agronomic data for north Florida, Georgia. Also, AL, MS. Less so for LA, TX.
  - Strong commercialization potential
- Stakeholder interest in understanding USDA FPAC agency policy interpretations for harvested winter oilseeds in the Midwest and Southeast
  - Is there an opportunity to support “functional cover crops” that are harvested?
  - What information would NRCS require for a winter oilseed crop to be considered a “Resource Conserving Crop”?

# Grass2Gas



PURPOSE STATEMENT

Advancing an **agricultural value chain** based on the production of *renewable natural gas (RNG)* and associated products through the **anaerobic digestion** of herbaceous feedstocks combined with manure



Award #2020-68012-31824

Funding amount: \$10M

Timeline: 2020-09-01 to 2025-08-31

Lead PD: Lisa Schulte Moore, Iowa State University

Partner Institutions: Iowa State University, Penn State University, Roeslein Alternative Energy, FDCE, USDA ARS National Lab for Agriculture and the Environment



[cchange.research.iastate.edu/grass2gas](https://cchange.research.iastate.edu/grass2gas)



# Cover Crops Widely Known to Provide Substantial Agro-Environmental Benefits in Annual Cropping Systems



Image: Fertilized harvested rye plots in Central Iowa, mid-May 2019; Image Source: Rob Malone, USDA-ARS National Lab for Agriculture and the Environment

For more information: Kaspar and Singer. 2011. The use of cover crops to manage soil. Soil management: Building a stable base for agriculture, 321-337.

# Allowing Cover Crop Termination Through Harvest Could Encourage more Wide-spread Adoption

## **New research indicates positive impacts from harvesting fertilized winter rye grown in a corn-rye-soybean rotation**

- Long-term winter rye biomass yield across drained North Central US corn-soybean belt before soybean planting was over 5 Mg/ha (2.2 t/ac) on average without a soybean yield reduction (Malone et al. 2023)
- Central Iowa field study showed rye biomass yield before soybean planting of about 6 Mg/ha (2.7 t/ac) and potentially positive producer revenue (cost and revenue of ~\$100 and \$400 per Mg), but perhaps a small soybean yield reduction (Herbstritt et al., 2022; Malone et al., 2022)
- Most studies find increased net returns and greater overall crop production per unit area with relay or double cropping (e.g., corn-rye-soybean) than prevailing systems (Tanveer et al., 2017)

Sources: Herbstritt et al. 2022. Rye as an energy cover crop: management, forage quality, and revenue opportunities for feed and bioenergy. Agriculture; Malone et al., 2023. Harvested winter rye energy cover crop: multiple benefits for North Central US. Environmental Research Letters; Malone et al. 2022 Rye-soybean double-crop: planting method and N fertilization effects in the North Central US. Renewable Agriculture and Food Systems; Rogovska et al, 2023, Long-term conservation practices reduce nitrate leaching while maintaining yields in tile-drained Midwestern soils, Agricultural Water Management; Tanveer et al., 2017. Relay cropping as a sustainable approach: problems and opportunities for sustainable crop production. Environmental Science and Pollution Research.

Funding: This research was a contribution from the Long-Term Agroecosystem Research network and was supported by the USDA-ARS. Further support was provided by USDA-NIFA (2020-68012-31824) and USDOE-BETO (EE0007088).

# Harvested Winter Rye Could be Used along with Other Feedstocks for Biogas Production

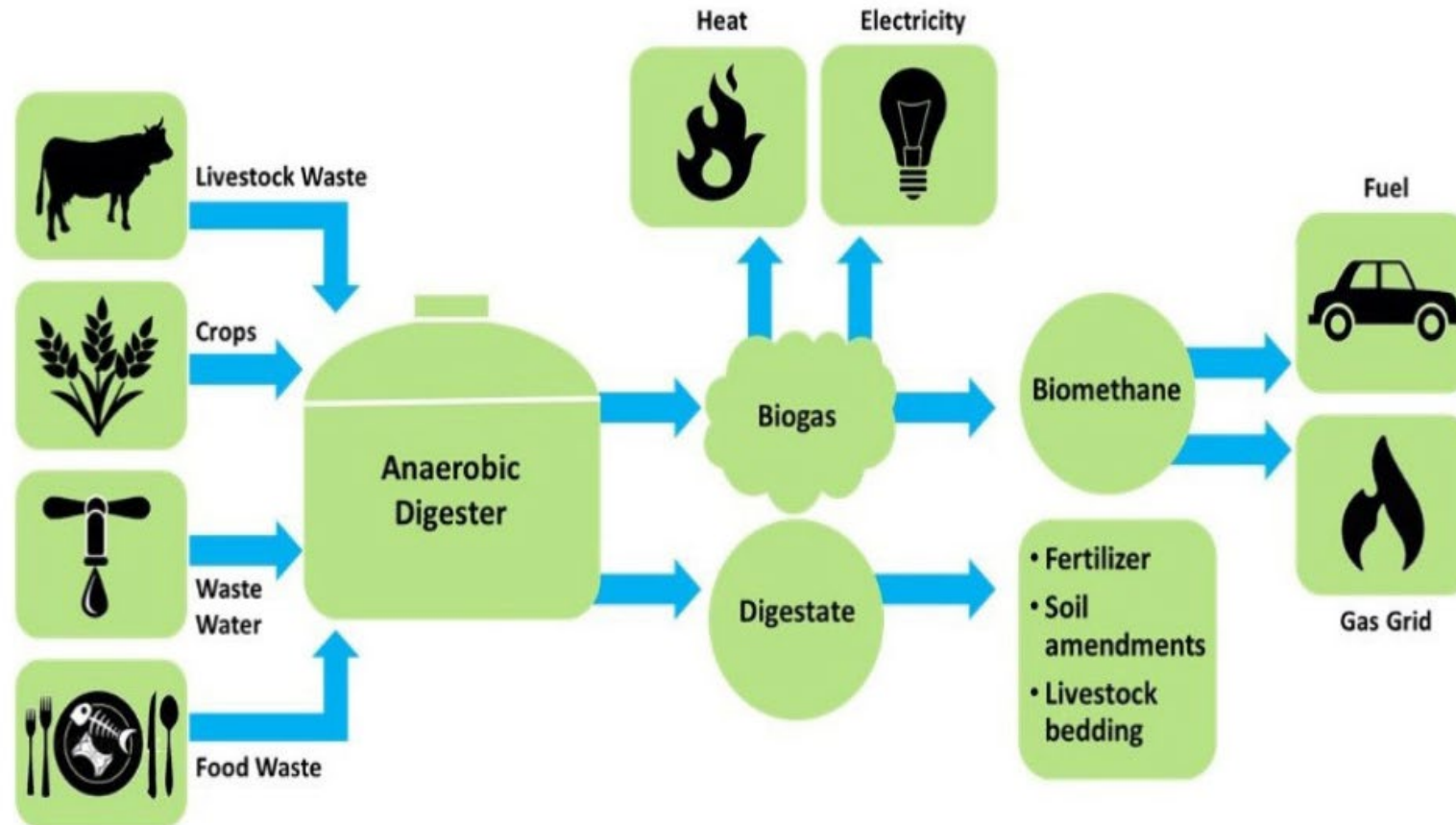


Figure 1: Anaerobic digestion process (Graphic by Sara Tanigawa, EESI).

# Cover Crop Adoption is Inhibited by Crop Insurance

- Some Corn Belt farmers believe cover crops can lead to yield declines, at least in the short term (Arbuckle and Roesch-McNally 2015; Roesch-McNally et al. 2017)
- Small but widespread yield declines in North Central US corn and soybean yields are supported by empirical evidence (e.g., Dienes et al. 2023; note the analysis does not account for farm-level goals, which could be profit or soil health instead of maximal yield, nor crop management)
- The willingness of some Corn Belt farmers to adopt cover crops is reduced by concerns about reduction in Actual Production History (APH) and potential crop insurance payout that are concomitant with yield declines (Ranjan et al. 2020)
- Among Iowa farmers, county-level crop insurance level was negatively associated with no-till and cover crop adoption (Upadhaya et al. In press); faith in crop insurance as a protective mechanism was negatively related to cover crop use (Upadhaya and Arbuckle 2021)

Sources: Roesch-McNally et al. 2018. Barriers to implementing climate resilient agricultural strategies: The case of crop diversification in the U.S. Corn Belt. *Global Environmental Change* 48:206–215; Roesch-McNally et al. 2017. The trouble with cover crops: Farmers' experiences with overcoming barriers to adoption. *Renewable Agriculture and Food Systems* 33(4):322–333; Dienes et al. 2023. Recent cover crop adoption is associated with small maize and soybean yield losses in the United States. *Global change biology*, 29(3), 794-807; Ranjan et al. 2020. Conversations with non-choir farmers: Implications for conservation adoption. Report for the Walton Family Foundation. *Sociology Technical Reports* 16. [https://lib.dr.iastate.edu/soc\\_las\\_reports/16.](https://lib.dr.iastate.edu/soc_las_reports/16.); Upadhaya et al. 2023. Individual- and county-level factors associated with farmers' use of 4R Plus nutrient management practices. *Journal of Soil and Water Conservation*: In press. Upadhaya and Arbuckle. 2021. Examining factors associated with farmers' climate-adaptive and maladaptive actions in the US Midwest. <https://www.frontiersin.org/articles/10.3389/fclim.2021.677548/full>

Funding: USDA-NIFA; Walton Family Foundation; Iowa State University



# Input from Stakeholders

- Perceived bottlenecks for the commercialization of winter oilseed crops and annual grasses
  - There is not a shared definition for harvested winter oilseeds or annual grasses among RMA, NRCS, and FSA. Second crop/double crop/winter crop/cover crop/intermediate crop?
  - Full insurance of the primary crop is negated by the planting and harvest of a winter crop even if the primary crop (i.e., soybeans) is planted before the insurance planting cutoff date (treated as a double crop).
  - Harvested winter oilseed crops provide ecosystem services but are not eligible for NRCS planting incentive programs?
  - Are there data that could inform statutory/policy decisions to support winter oilseed crops to increase adoption?
  - FPAC is interested in receiving additional agronomic data sharing.
    - Based on peer-reviewed publications
    - Additional data may be available from industry
      - Need to understand data parameters (years, locations, # of acres, etc.)

# USDA Partnerships for Climate Smart Commodities

- **Climate-Smart Camelina**

- This large-scale pilot project aims to measure and validate the climate-smart advantages of Camelina sativa (L.) in both rotational and winter cover crop production systems and build associate climate-smart biofuels markets. **The project will accelerate farmer adoption of camelina as a non-food crop** grown on idle acres to produce more plant-based feedstock for renewable biofuels and chemicals with low carbon intensity and no land-use change while increasing carbon capture in the soil.
- **Lead Partner:** Global Clean Energy Holdings, Inc.  
**Other Major Partners:** Sustainable Oils, Bakersfield Renewable Fuels, ExxonMobil, Farmobile/AGI, Davis Instruments, Pessl Instruments, EarthDaily Agro, Intelinair, Earth Optics, Yard Stick, ARVA Intelligence  
**Primary States Expected:** ID, CO, KS, MO, MT, OK, OR, TX, WA, WY, Tribal  
**Major Commodities:** Camelina
- **Approximate Funding Ceiling:** \$30,000,000

# USDA Partnerships for Climate Smart Commodities

- **The GEVO Climate-Smart Farm-to-Flight Program** (Links to the Sustainable Aviation Fuel Grand Challenge)
- The project aims to **create critical structural climate-smart market incentives for low carbon-intensity corn** as well as to accelerate the production of sustainable aviation fuel to reduce the sector's dependency on fossil-based fuel. This project includes an **immediate market opportunity to sell climate-smart, low-climate-impact corn**.
- **Lead Partner:** Gevo, Inc.  
**Other Major Partners:** Southwest Iowa Renewable Energy, LLC, Google, Farmers Edge, EarthOptics, South Dakota State University, Regen Ag Labs, Yard Stick, Double H Ag Services, Farmers Edge, AgSpire, PrairieFood, Stine Seed Farm, Holganix, Trace Genomics, MidState Agronomy, Double H Ag Services, Colorado State University, Iowa State University, Standing Rock (SAGE) Renewable Energy Power Authority  
**Primary States Expected:** MN, SD, NE, IA, Tribal  
**Major Commodities:** Corn
- **Approximate Funding Ceiling:** \$30,000,000



Thank You!

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