Clean Fuels Development in the Southwest and Related Topics

Figure 2

RoundTable Agenda 25 November 2025

Short Round the Room Introductions

Name, Company, Where you sit in the value chain

Discussion Topic:

Biomass to X
Led by Bill Brandt (ASU), and team

Roundtable Prompts

AzCaNE | CENTER FOR AN ARIZONA CARBON-NEUTRAL ECONOMY

SHINe

In the spirit of co-opetition, the Industry Roundtable aims to build community and establish a shared understanding of challenges, opportunities, gaps, and needs for a commercially viable clean hydrogen economy in the Southwest and related means to achieve deep decarbonization

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2. *Given clear technology readiness levels and a persistent feedstock-supply uncertainty, what single change—policy, contracting tool, financing mechanism, or operational reform—would most rapidly move biomass projects from 'promising' to investment-grade?*
3. *If we view 4FRI as a true regional innovation ecosystem rather than a set of isolated projects, which mix of end products—biochar, power/CHP, wood fiber boards, e-methanol—would create the most resilient portfolio for Northern AZ, and why?"*

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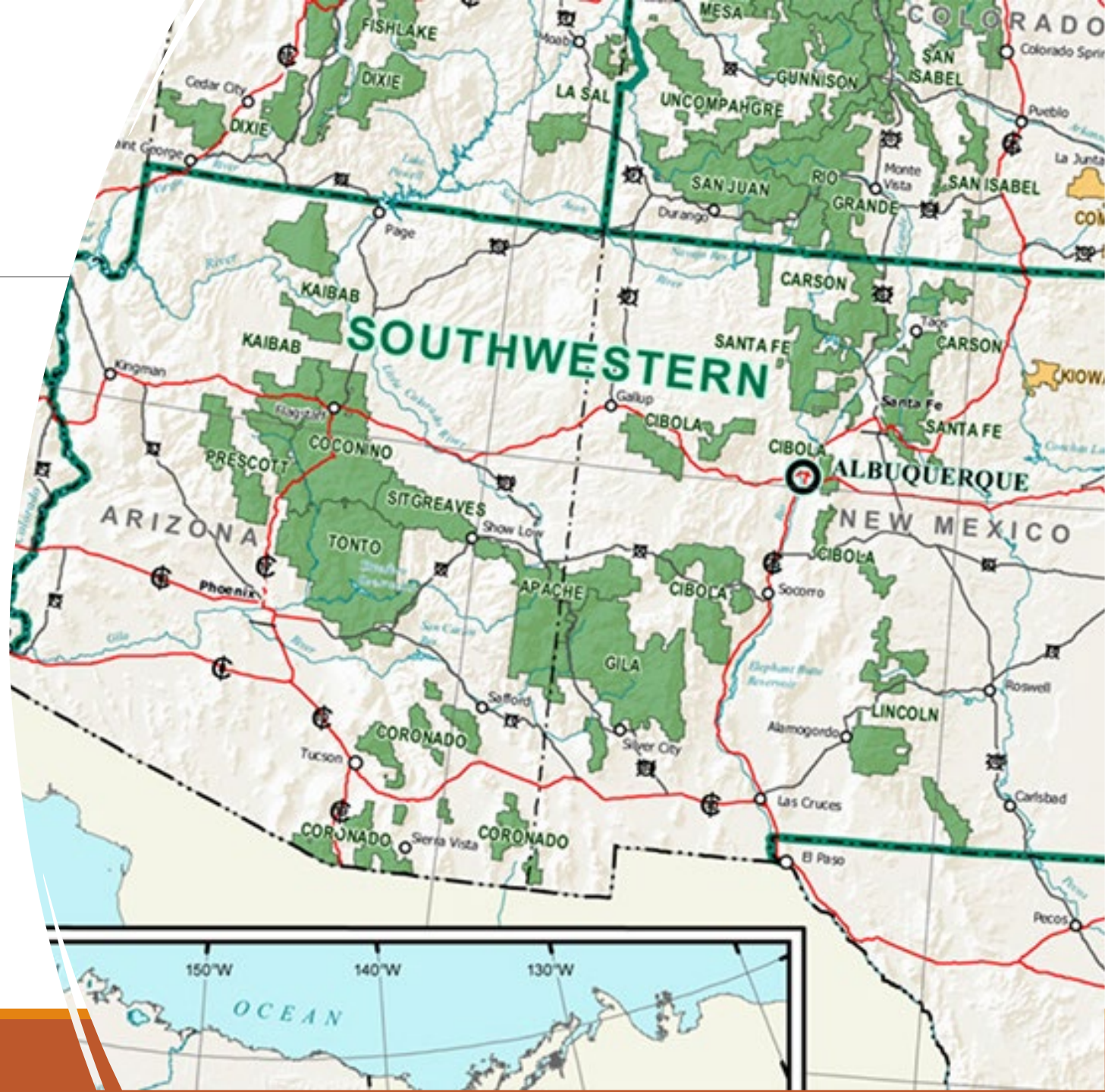
Biomass-to-X

BRIEFING FOR AzCaNE ROUNDTABLE

NOVEMBER 25, 2025

Regional Market Context

- Grid stress + industrial expansion increasing demand
- Wildfire & watershed exposure shaping investment
- Southwest carbon & materials markets rapidly emerging
- Biopark: aligned with real regional and industrial needs



Ponderosa Utilization Summit

The Gaps are clearer:

- Supply consistency over longer periods
- infrastructure gaps and mill limitations
- low-value fiber, market innovation needed to higher value
- Workforce + affordable housing = essential to scaling

CING PONDEROSA PINE MARKETS IN THE WEST:

NG A STRATEGIC VISION FOR THE FUTURE

o develop a strategic vision addressing key challenges and oppo
sa Pine industry-focused on innovation, infrastructure, policy, a

IT AT-A-GLANCE

NTRY CONFERENCE CENTER

18-19

sentations and panels, facilitated sessions,
king

SCAN THE Q
DRAFT AG
REGIST

Introducing the team

Jeffrey Jacobs – Technology pathways and siting considerations,

Ed Salzberg – Contract structures, organizational design, and governance

Ryan Klenner – The Data Room and industry engagement

Bill Brandt – Emerging ideas and Bankability

Woody Biomass Technologies vs. Commercial Availability

Ready Now

Biomass power / CHP — Long operating history; U.S. wood & waste-biomass capacity holding steady through 2025 (industrial/commercial wood capacity ≈ 5+ GW). Typical schedule 18–30 months greenfield; faster if repowering existing sites. *Key risks:* fuel logistics, air permits, competitiveness with conventional power generation sources.

Wood Fiber & Wood-Wool panels — Long commercial history in EU (e.g., **GUTEX**); U.S. manufacturing launched: **TimberHP** began U.S. production/shipping of wood-fiber boards in Maine (2025). *Key risks:* distribution build-out, location specific building and fire code approvals. *(Examples: TimberHP, GUTEX; wood-wool cement panels like **WoodSyn**'s OptimWall™)*.

Biochar & Carbon Casting Technologies — Commercial today from small scale modular units to municipal deployments (e.g., **KUG, Graphyte**); growth driven by the carbon markets. Typical schedule 12 to 18 months for modular units. *Key risks:* feedstock logistics, environmental requirements, carbon-credit MMV & offtake, scaling to impact requires multiple modules.

EARLY STAGE / FIRST-OF-A-KIND (3 TO 7 YEARS)

e-Methanol (electro-methanol) — **Operational FOAK**: European Energy's Kassø plant (Denmark) inaugurated 2025 at ~42 kt/yr; early offtake includes Maersk. Other flagship projects canceled in 2024–2025 over offtake and economics (e.g., Ørsted's FlagshipONE). *Key Risks:* technically feasible, but deployment depends upon long-term offtake contracts, low-cost renewable H_2/CO_2, and generous policy support.

Emerging / Not Ready (7+ years)

- **RNG (renewable natural gas)** — Market is broadly commercial and based upon anerobic digestion of animal wastes. RNG Coalition reports ~500 operational facilities in North America, 2025). *Key Risks:* Technology not ready for the 4FRI given challenging woody biomass feedstock chemistry, pipeline interconnect requirements, and credit-market dependencies. Monitor technology should policy support, pipeline access, and capital availability improve.

4FRI West Side – Potential Biomass Sites

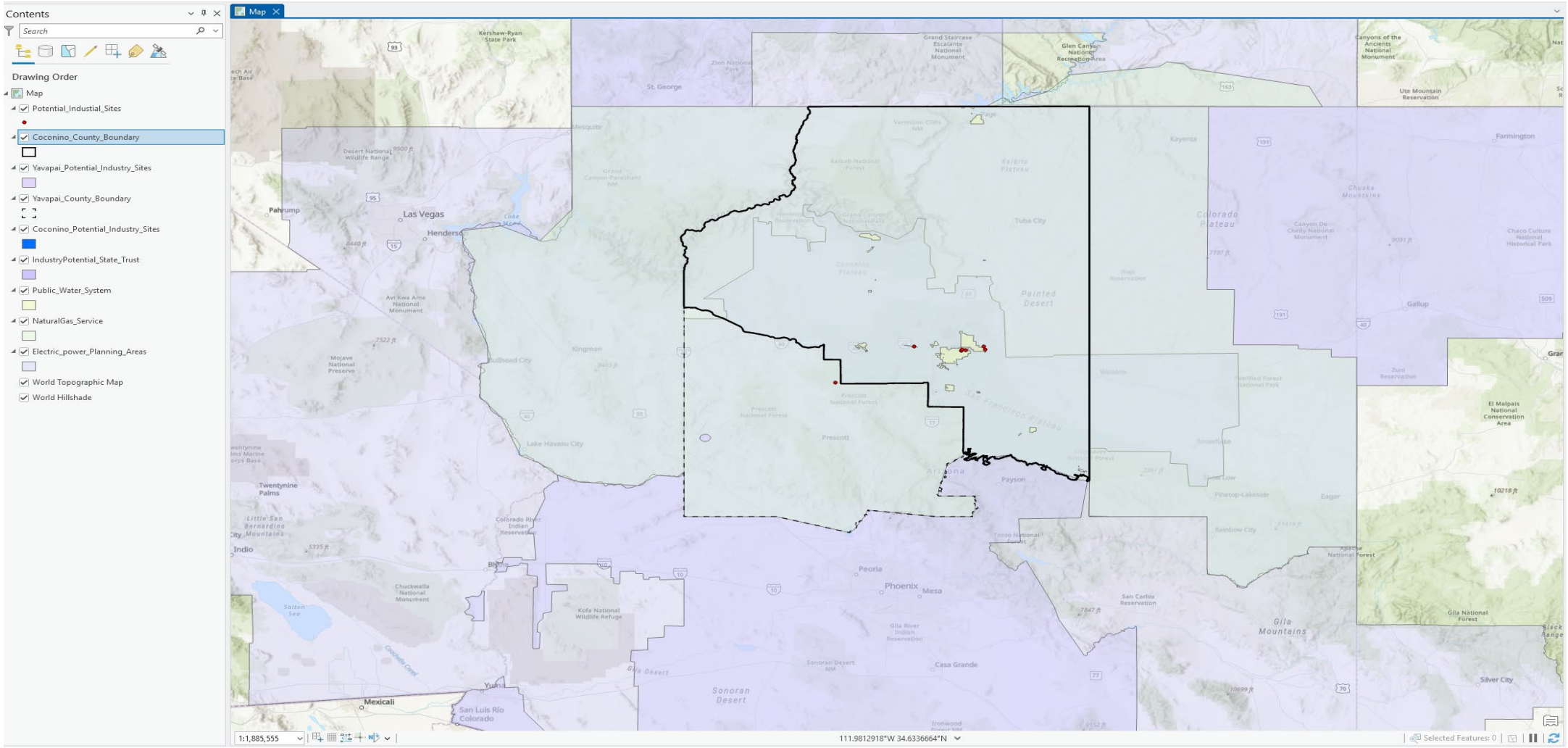


Image sourced from: Coconino County Forest Restoration

4FRI East Side – Potential Biomass Sites

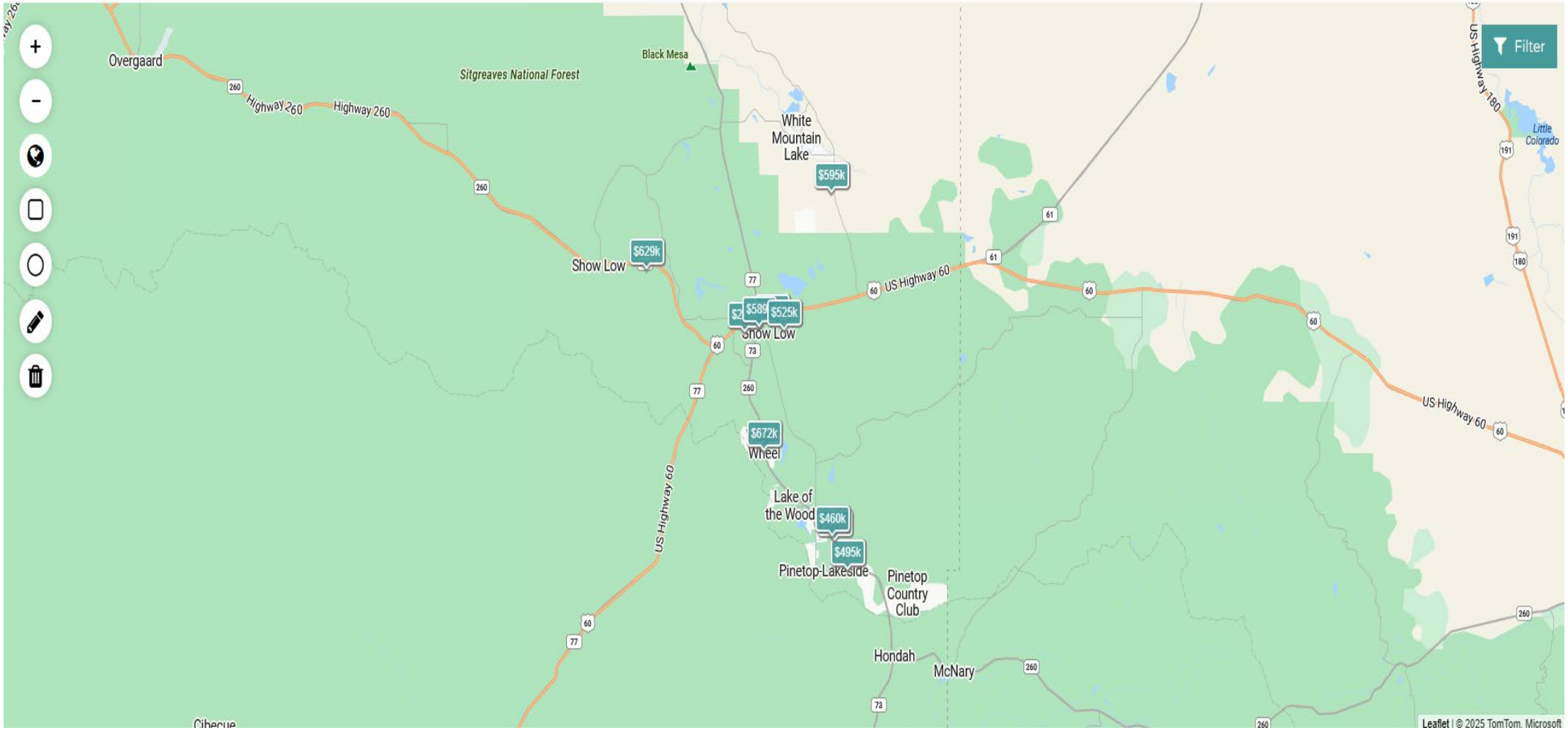


Image Sourced from RealAZ (https://realaz.idxbroker.com/idx/map/mapsearch)

Framing the Problem:
Why Biomass Is Not Yet Bankable

Large volumes of low-value, unmerchantable biomass

→

Serious developers downstream, weak market in the middle

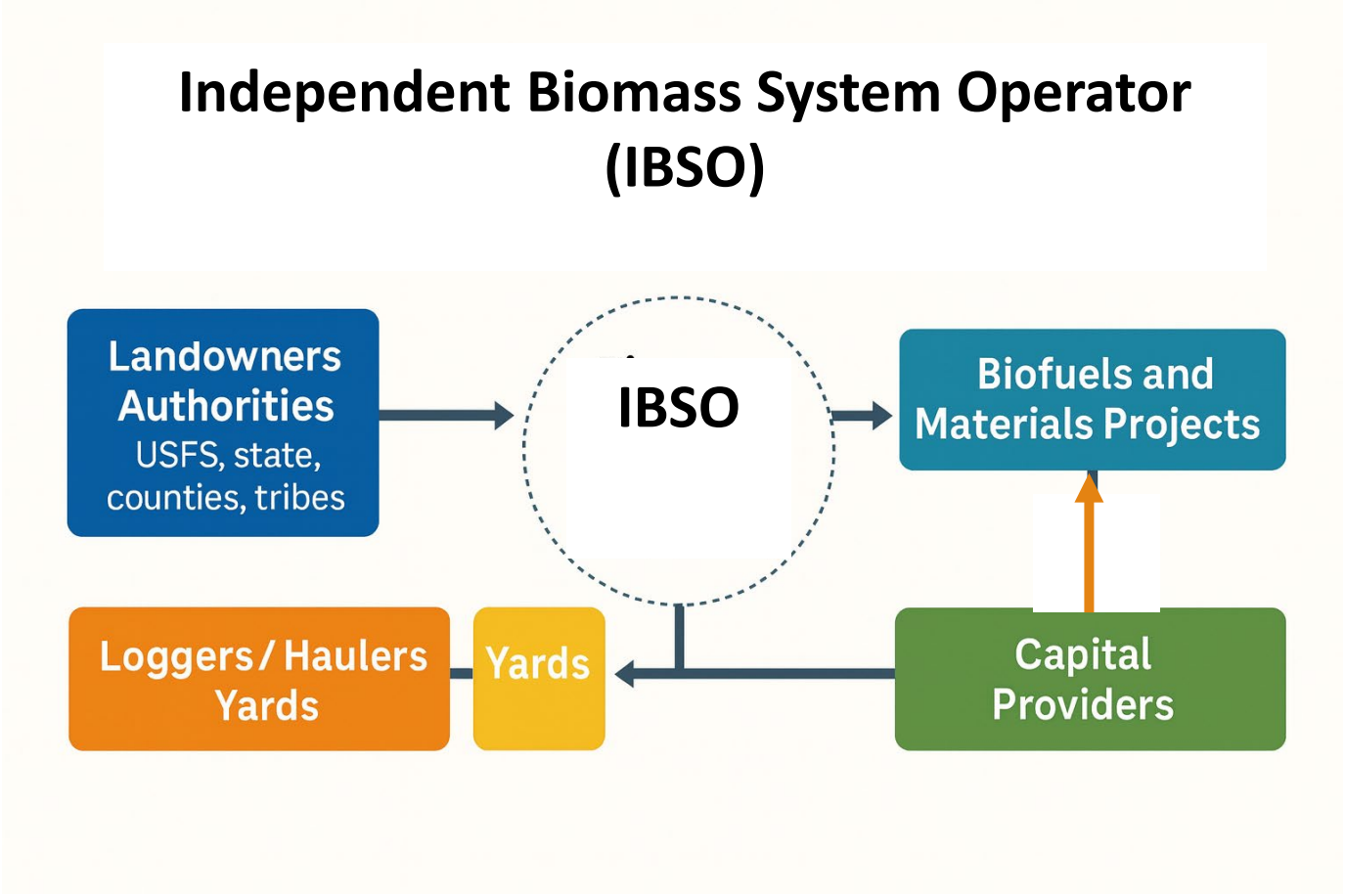
↓

Fragmented contracts, fragile logistics, no system accountability

←

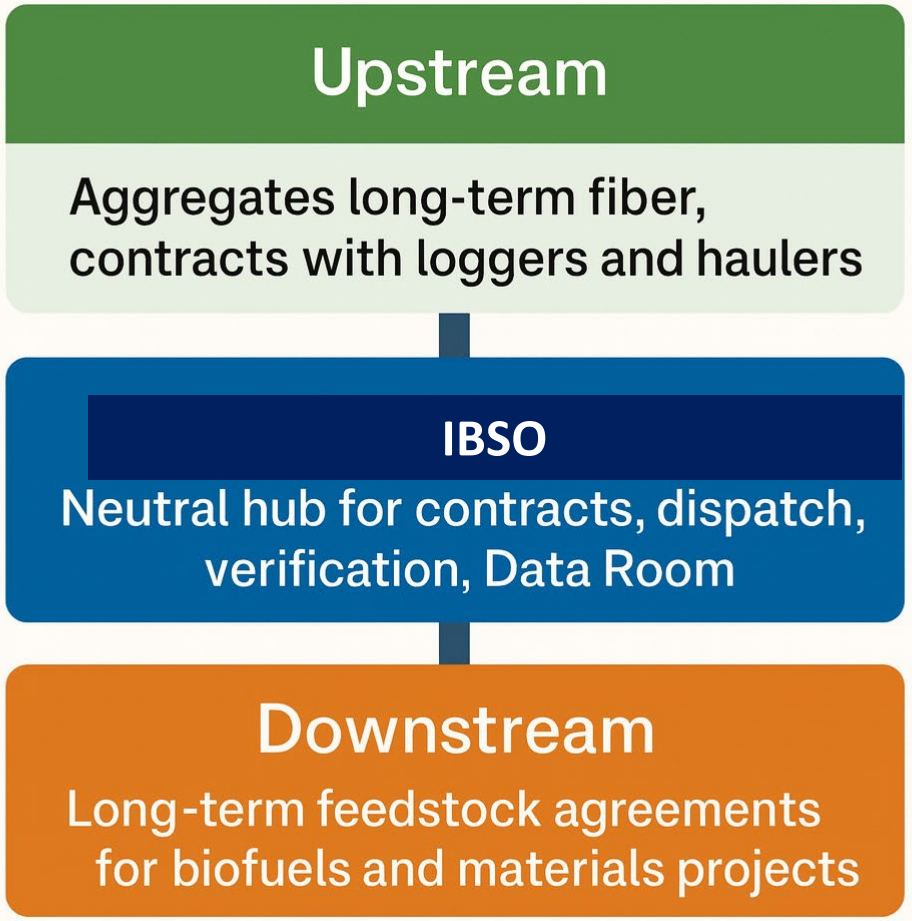
To investors, forest fiber still looks volatile

Value Chain and The Missing Independent Biomass System Operator (IBSO)



- Each actor now optimizes its own piece
- No neutral party manages flows, contracts, and risk
- We need an ISO-like market manager for biomass

Independent Biomass System Operator
Functions and Possible Forms



Core functions: aggregate supply, manage logistics and contracts

- **Possible forms:** member co-op, community / special-purpose public entity, or for-profit operator (SIXco-type model), others?
- Spreads and manages risk across forests, contractors, and projects

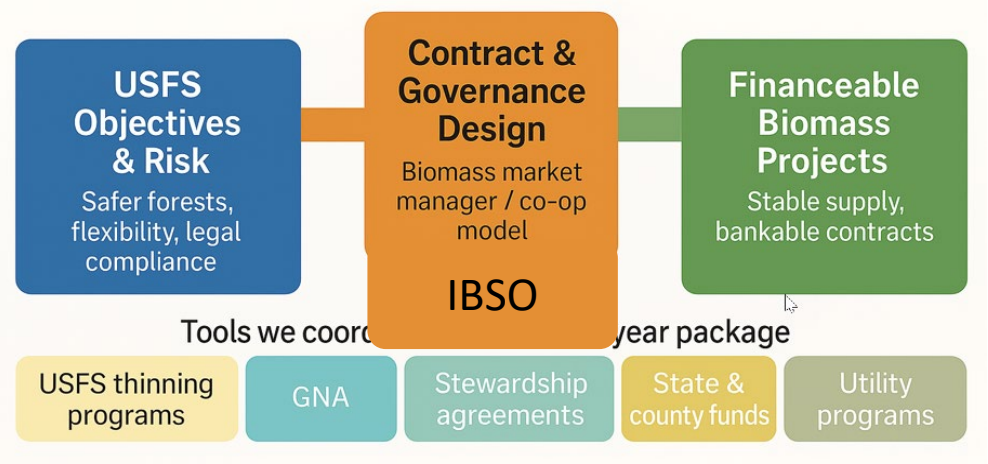
USFS Contracts, Risks and Tools

USFS CONTRACT AND OBJECTIVES

Mandate to design a financeable biomass market architecture

Align long-term supply confidence with USFS flexibility and safety goals

Diagnose and identify procurement options to deliver stable feedstock at



TOOLS WE ARE COORDINATING

USFS thinning and biomass programs

State tools such as GNAs and stewardship agreements

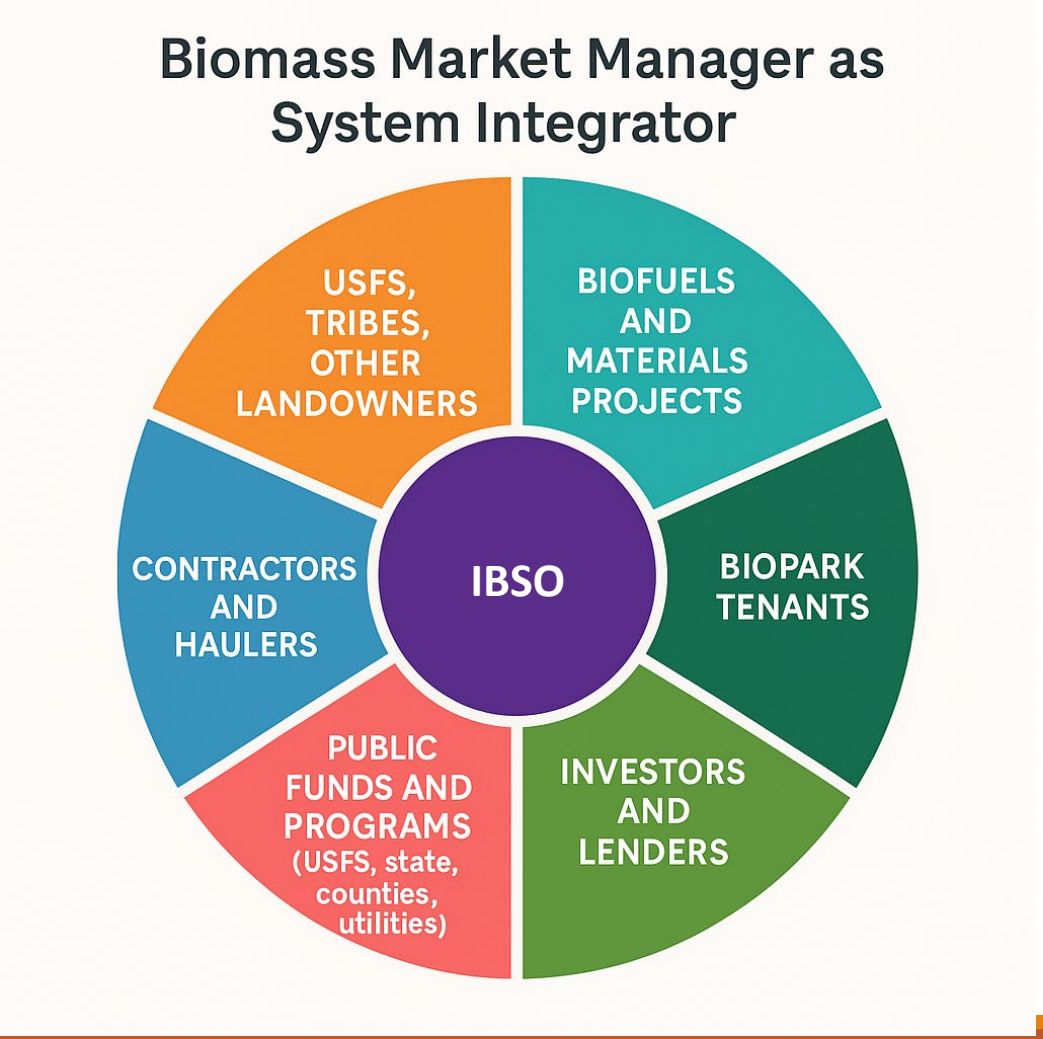
Recurring thinning and collection funds from USFS, state, counties, utilities

Risk of failing to make forests safer, and the need for legal and policy compliance

Biomass Market Manager
As The System Integrator Serving

- **Developers:** What do you need in 10–20 year feedstock deals?
- **Financiers:** Would this structure pass your screens?
- **Federal and State Responsibilities**: Does the structure reduce risk and meet thinning goals
- **Utilities:** Are the benefits sufficient to engage?
- **Public, tribal, communities, NGO partners (e.g., TNC):** Guidance on governance roles.

Governance: Board or membership structure must give USFS, tribes, counties, communities, and NGOs an authentic voice, regardless of its form.



4FRI Data Room – Executive Summary

What is it:

A ready-to-use data room that links 4FRI forest feedstock, maps, and cost models to speed investor due diligence.

Who will use it:

Built specifically for investors, project developers, technology providers, and public partners who are focused on the Northern Arizona 4FRI region.

Key Functions: Arc GIS - Transparency – Policy & Contracts – Simple Navigation – Engagement analytics

4FRI Data Room – Organization (1 of 2)

BACKGROUND

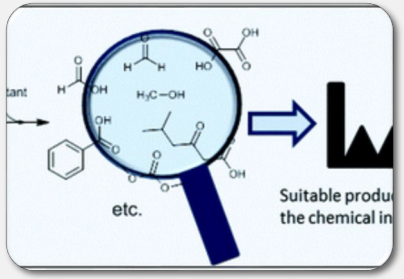
Forest fires, social/economic & watershed impacts, the 4FRI region, logging/chipping costs, and key documents.

MARKET RESEARCH

Production & Selling Costs: CAPEX/OPEX and revenue assumptions for Biochar, CDR, CHP, E-methanol, RNG.

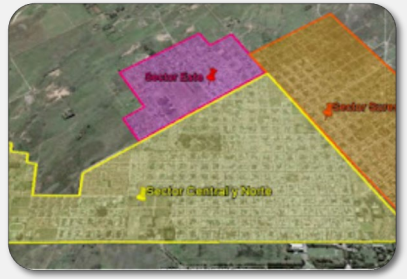
FOREST PRODUCTS

Companies & research across Biochar, Gasification, Power & Heat; includes USA & Europe indexes.



FEEDSTOCK CHARACTERIZATION

Characterization of Ponderosa Pine & Pinyon-Juniper residues; clean/white wood chips & sawdust analyses.



PHYSICAL CHARACTERISTICS

Maps, available sites, processors, feedstock acres/volumes, utilities, transmission lines, and infrastructure.

4FRI Data Room – Organization (2 of 3)

HARVESTING

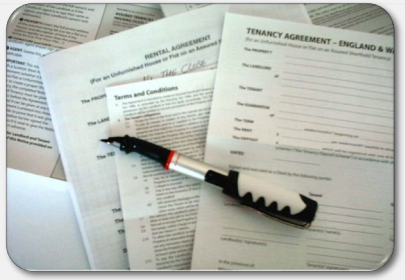
Stewardship agreements, seasonal constraints (winter, owl nesting, fire season), and historic utilization.

MANAGEMENT POLICY

USFS contract types, procurement pathways, next-generation stewardship concepts, and reference papers

MODELLING

Optimization and financial models to compare technology pathways and siting options effectively.



RESPONSIBILITIES & CONTRACTS

A comprehensive roles directory for all involved agencies, partners, and key contacts.

OTHER RESEARCH PAPERS

Additional literature and supporting documents to aid in detailed decision-making.

**** The data is public but currently limited to token holders to help cover platform costs; engaged stakeholders have given useful, constructive feedback.**

4FRI Data Room: Feedback

- **Investor-Ready Packaging:** Mirrors an M&A data room for fast screening.
- **End-to-End View:** Connects operations to conversion economics.
- **Site Clarity:** Layers for power, gas, and roads make "where to build" concrete.
- **Feedstock Specificity** Deep data on Ponderosa Pine & Pinyon-Juniper.
- **Multi-Product Optionality:** Pathways for Biochar, RNG, E-methanol, Power & Heat.
- **Risk Visibility:** Explicit seasonality and harvest black-outs.
- **Transparent Sources:** Every claim is referenced and easy to audit.

Emerging Concepts

Utilization conference:

USFS recognition of long-term contracting vehicles. Focus on all users.

Go digital (TNC Walker Hill)

Develop an “Innovation Ecosystem” focused on

- Consistent lowest delivered cost
- A system operator that has access to aggregation yards that can buffer supply blips
- System diversification of revenue

System Finance Requirements

- Consistent feedstock certainty
- Technology readiness & deployment clarity
- Market & offtake agreements
- Governance & risk allocation
- Policy and hybrid financial (no one party can fix this)
- Strong project unit economics + support = reduced WACC

Updated Call to Action for Northern Arizona

ACCELERATING BIOMASS-TO-X AND 4FRI IMPLEMENTATION

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Thank you for your participation

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