Enhanced Proposal for Cardboard Collection and Recycling Services

Submitted by Frame&InFill | Prepared for Oak Ridge National Laboratory (ORNL)

1. Executive Summary

Frame&InFill proposes a cutting-edge, closed-loop cardboard recycling and energy conversion system that reduces labor requirements, reuses waste materials into modular infrastructure, and powers AI data centers via a small-scale Waste-to-Energy (WtE) plant. This system is designed to respect and enhance union jobs while turning ORNL into a national model of circular innovation.

2. Collection System Redesign

- Smart IoT-equipped bins with integrated compactors at key campus locations.
- Humanoid robots (e.g., from Figure AI) sort and load cardboard, reducing injuries and repetitive stress.
- Autonomous Guided Vehicles (AGVs) navigate along campus paths, delivering compacted cardboard to the processing hub.

3. Cardboard Reuse: Honeycomb Partition Manufacturing

- On-site facility converts recycled cardboard into honeycomb-core wall panels.
- Panels are used for temporary offices, event booths, and lab partitions.
- The honeycomb design enhances acoustic dampening and lightweight modularity.
- Operators are trained from the existing unionized workforce.

4. Waste-to-Energy Plant Specifications

- Proposed location: near the western edge of the ORNL campus, adjacent to Bethel Valley Road and the logistics corridor (ref. ORNL site maps).
- Capacity: 2.5-5 tons/day of residual cardboard and compatible biomass.

- Technology: Modular gasification or pyrolysis unit with emissions capture.

- Output: ~1.5 MW electrical capacity, routed to support ORNL's AI data centers and robotic systems.

- Heat byproduct redirected to drying chambers or greenhouse operations.

- Community benefit: excess capacity can be sold to nearby UT and East Tennessee Tech Park facilities.

5. Circular AI Infrastructure Loop

- Cardboard waste -> reused in wall panel production OR -> converted to electricity.

- Electricity powers ORNL AI clusters and infrastructure automation.

- Human roles redefined as operators, technologists, and process overseers.

6. Workforce Integration Plan

- All existing union roles preserved with upskilling into robotics, WtE plant ops, and honeycomb production.

- Modular training programs designed in partnership with UT Outreach Center.

- Safety-first design and phased rollouts ensure smooth transitions.

7. Implementation Timeline

Phase 1 (0-3 Months): Deploy smart bins, start AGV pilots, union onboarding.

Phase 2 (3-9 Months): Begin honeycomb panel production, train WtE plant staff.

Phase 3 (9-18 Months): Full WtE integration, AI routing optimization, scale to service neighboring partners.

8. Sustainability and Community Metrics

- >=60% cardboard reused in product form.

- 100% of non-recyclables converted to power.
- ~1.5 MW electricity offset from WtE.
- >40% reduction in manual handling effort.
- 100% union retention with enhanced wages and skill profiles.

9. Why This Matters for ORNL

This initiative transforms ORNL into a beacon of 21st-century circular systems, where recycling, robotics, energy, and AI converge. The plan improves sustainability, respects its workforce, and builds public trust-while powering next-gen research.

Proposal for Cardboard Collection and Recycling Services

Submitted by Frame&InFill | Prepared for Oak Ridge National Laboratory (ORNL)

1. Executive Summary

ORNL requires a next-gen cardboard recycling strategy aligned with its leadership in sustainability and automation. Frame&InFill proposes a closed-loop system that reduces manual labor through robotics, reuses material in on-site honeycomb wall production, and routes unrecyclable waste into energy systems powering ORNL AI data centers.

2. Collection System Redesign

- Smart bins with IoT sensors and compactors optimize pickup timing.
- Humanoid robots from Figure Robotics assist in sorting and loading tasks.
- Autonomous Guided Vehicles (AGVs) transport materials, reducing manual handling and fuel use.

3. On-Site Recycling & Modular Reuse

- Recycled cardboard is converted into durable honeycomb-core wall panels.
- These are used for modular partitions, labs, and pop-up structures.
- Union workers retrain as robot operators, AGV supervisors, and fabrication techs.

4. Waste-to-Energy + AI Synergy

- Non-recyclable material is directed to waste-to-energy systems.
- Electricity powers AI compute nodes.
- Waste heat is reused in greenhouses or drying kilns for panels.

5. Sustainability Metrics

- >=60% cardboard reused in panels

- >=40% reduction in manual labor

- 100% workforce retained and upskilled

- 100% energy reuse from unrecyclables

6. Implementation Timeline

Phase 1 - Pilot (90 Days): Install bins, train workers, deploy AGVs

Phase 2 - Expansion (180 Days): Launch panel production, add robots

Phase 3 - Campus-wide (12 Months): Full automation and energy loop

7. Why ORNL

This proposal reinforces ORNL's mission of pioneering research and sustainable operations. It bridges recycling, robotics, and energy into a model campus-wide solution. It protects union jobs while modernizing the facility through clean innovation.

ChatGPT

Title: Cuttlefish RAG: Empowering Deep Forge with AI-Driven Knowledge Retrieval

Subtitle: Enhancing Defense and Energy Innovation Through Real-Time Data Integration

Prepared by: Cuttlefish Labs
Date: June 15, 2025
Audience: U.S. Department of Energy (DOE), Appalachian Regional Commission (ARC), Office of the Vice President

---

Page 1: Cover Page

Visual: A futuristic interface showing a RAG system querying Deep Forge documents (e.g., AI schematics, DOE policies) with glowing vector embeddings and a chatbot response. Background: Appalachian mine transformed into a high-tech hub.
Logo: Cuttlefish Labs logo (placeholder: cuttlefish with circuit patterns).
Details: Prepared for DOE, ARC, and VP Vance's office. Contact: [your email], [your phone].
Purpose: Establish a professional, innovative tone and tie the RAG system to Deep Forge's mission.

Page 2: Executive Summary

Cuttlefish Labs' Retrieval-Augmented Generation (RAG) system is a cutting-edge AI framework designed to enhance Deep Forge's operations by grounding large language models (LLMs) in real-time, domain-specific data. Integrated with Deep Forge's underground AI-powered defense and energy hubs in Appalachia, the RAG system retrieves critical documents—such as DoD technical specifications, DOE critical materials policies, and metallurgical coal data—to deliver precise, verifiable responses for stakeholders.

By leveraging vector databases and OpenAI embeddings, the system ensures accuracy and context, reducing LLM hallucinations and supporting multi-domain operations (JADC2). Key use cases include automating grant applications for ARC's POWER Initiative ($2M–$5M) and DOE's Advanced Energy Manufacturing Grants ($425M Round 2), querying AI manufacturing workflows, and briefing VP Vance's office on national security impacts.

The system extracts text from PDFs using PyMuPDF, stores embeddings in FAISS, and generates responses via LangChain and GPT-4. Deployable by Q1 2026, the RAG system aligns with DoD's AI Ethical Principles and CMMC 2.0 cybersecurity standards. It will create 500 AI and data science jobs, supporting ARC's economic goals.

Cuttlefish Labs requests $10M from DOE and ARC to pilot the RAG system at a West Virginia Deep Forge site, complemented by $5M in $NEXUS token investments on Cardano. This initiative positions Deep Forge as a leader in AI-driven innovation, securing U.S. defense and energy resilience.

Visual: Infographic with RAG pipeline (Retrieval → Augmentation → Generation) and icons for PDFs, vector database, and LLM chatbot.

Page 3: RAG System Architecture

Overview: The Cuttlefish RAG system combines information retrieval with generative AI to ground responses in Deep Forge's knowledge base (e.g., technical manuals, grant guidelines, DoD policies).

Components:
- **Data Preprocessing:** Extracts text from PDFs using PyMuPDF, handling scanned documents with OCR (Tesseract). Chunks text into 500-word segments.
- **Embedding & Storage:** Converts text to vectors using OpenAIEmbeddings (GPT-4). Stores in FAISS for fast similarity searches.
- **Retrieval:** Queries vector database using cosine similarity to return top-5 relevant documents.
- **Augmentation:** Combines retrieved documents with the user query using prompt engineering.
- **Generation:** Uses LangChain and GPT-4 to produce accurate, cited responses.

Security: Implements zero-trust architecture and quantum-resistant encryption (CMMC 2.0).
Scalability: Handles 100,000 PDFs with sub-second query response times.

Visual: Diagram of pipeline: PDF input → PyMuPDF → FAISS → GPT-4. Sample query: "How does Deep Forge align with ARC POWER Initiative?"

Page 4: Use Cases for Deep Forge

- **Grant Applications:** Queries ARC and DOE grant rules to draft compliant proposals 50% faster.
- **AI Manufacturing Support:** Retrieves AI schematics and manuals to support robotic production lines, boosting efficiency 30%.
- **Stakeholder Briefings:** Tailors reports for VP Vance's office using DoD policy and coal data.
- **Energy Optimization:** Optimizes 10 MW geothermal and 5 MW WTE microgrids for DoD climate goals.
- **Workforce Training:** Retrieves educational content for 500 AI/data science workers.

Visual: Table of use cases, benefits, and aligned priorities. Photo of chatbot interface answering a grant query.

Page 5: Implementation Plan and Call to Action

Timeline:
- **Q3 2025:** Prototype with 1,000 PDFs.
- **Q4 2025:** Pilot at WV Deep Forge site.
- **Q1 2026:** Scale to 100,000 documents, expand use cases.
- **2027:** Expand to KY, OH, PA, train 500 workers.

Funding Request: $10M ($5M DOE, $5M ARC) for development and cybersecurity. $5M in $NEXUS token investment.
Partnerships: OpenAI, LangChain, Quaise Energy, PA universities.

Call to Action: Fund the WV pilot. Schedule Q3 2025 demo of live document querying.

Visual: Gantt chart timeline and AI interface in a mine.

Design Notes: - **Color Scheme:** Navy blue, green, steel gray.
- **Typography:** Arial (body), Calibri (headings).
- **Visuals:** MidJourney prompts ("AI querying PDFs in underground Appalachian mine").
- **Branding:** Cuttlefish Labs logo and tagline: “Built from America’s Critical Materials. Powered by AI.”
- **PDF Tool:** Canva, InDesign, or Word with export. Balance 50% text, 50% visuals.