ZOLO CARBON SMARTECH

Enhancing U.S. Grid Reliability and Fuel Flexibility through Co-Fired Burner Retrofits with Zolo's Multi-Zone In-Furnace Monitoring and Supervisory Combustion Control

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Stabilize and Optimize Coal Power: Program Portfolio Kick-off Meeting
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Project Overview

Goal

Convert conservative, open-loop natural gas co-firing into a closed-loop, constraint-managed operating envelope by pairing host-appropriate multi-fuel burner retrofits with Zolo's real-time in-furnace laser sensing (ZoloSCAN2) and a supervisory combustion optimization layer.

Location

Prime: Zolo Carbon Smartech, Inc., Louisville, Colorado

Host site: candidate U.S. coal units under evaluation; preferred and alternate host selected in Phase I

Performance period

Phase I: 9 months from award effective date (pre-FEED and Phase II readiness)

Phase II: 12 months (FEED). Phase III: up to 36 months (implementation and validation), subject to down-select

Phase I funding summary

$400,000	$319,317	$719,317
Federal share	Recipient cost share	Total project value

Key participants

- Zolo Carbon Smartech, Inc. (prime): in-furnace sensing, supervisory control, integration
- Taber International: boiler optimization and operating envelopes
- Zeeco, Inc.: co-fired burner and fuel-train retrofit
- Host utility: to be selected in Phase I

Intended impact

- Fuel flexibility and dispatchable capacity from existing coal units without repowering
- Lower cost of generation through reduced efficiency penalty and shorter tuning campaigns
- Preserves plant operations and maintenance jobs at the host utility; supports engineering jobs at Zolo
- Transferable performance datasets to accelerate replication across U.S. cycling coal plants

Project Background and Technology

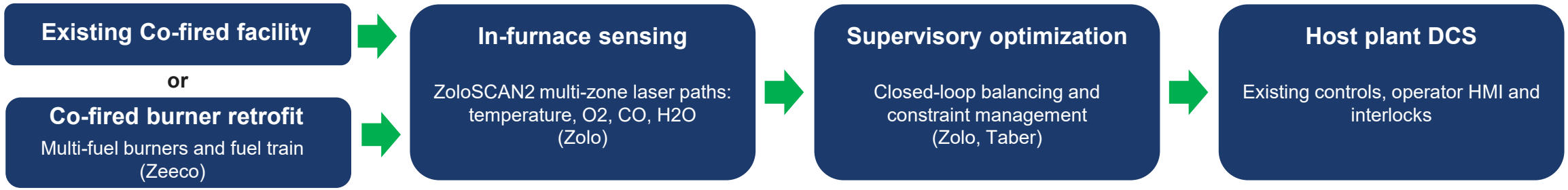
The problem

- Coal and natural gas differ in flame structure and heat release. Co-firing shifts furnace temperature and species distributions.
- Plants run co-firing conservatively with manual tuning because standard instrumentation (economizer O2, CEMS) gives no high-speed, multi-zone view inside the furnace.
- Result: efficiency penalties, longer commissioning, and a narrower operating window than the hardware allows.

The approach

- ZoloSCAN2: multi-path tunable diode laser absorption spectroscopy measuring temperature, O2, CO and H2O directly in the furnace, across multiple zones, in real time.
- Supervisory optimization layer closes the loop on burner and air distribution within the host plant's existing DCS.
- Host-appropriate burner and fuel-train retrofit sized for 20% to 50% natural gas heat input.

Integrated system



Host site profile

Target class: wall-fired and tangentially fired pulverized coal units in the 200 to 700 MW range expected to operate into the 2030s. Unit capacity, age, coal type, pollution control configuration and plant block flow diagram will be documented for the preferred host at Phase I Gate 2.

Project Scope and Technical Approach

Phase I tasks (pre-FEED and Phase II readiness)

1. **Project management and planning**
   PMP update, baselines, kickoff briefing, Gate 1 and Gate 2 reviews

2. **Combustion and burner measurement technology readiness**
   Measurement requirements and sensing architecture; screening data package; instrumentation gap assessment

3. **Integration and optimization platform readiness**
   Closed-loop control requirements; host integration architecture and interface specification

4. **Co-firing burner retrofit readiness**
   Retrofit pathway definition and rough order of magnitude inputs with the burner partner

5. **Site identification and Phase II readiness definition**
   Host screening against predefined criteria; preferred and alternate host; pre-FEED package (AACE Class 4) and Environmental Information Volume

6. **CCUS conceptual design**
   Post-combustion capture concept sized to the host site flue gas stream; battery limits, integration points and assumptions

Phase II (12 months)

- FEED for the Phase III installation with AACE Class 3 estimate
- CCUS pre-FEED integrated with the host site
- NEPA, permitting, initial HAZOP, EPC and cost share commitments

Phase III (up to 36 months)

- Procure, install and commission the integrated system at the host unit
- 2,000 hours of operational testing, including 1,000 continuous hours at steady state
- TRL 8 or higher validation, calibrated process models, CCUS FEED

Intended outcomes

- Validated co-firing envelope at 20% to 50% natural gas heat input
- Replicable retrofit and controls package for U.S. cycling coal units

Execution Plan and Schedule

Phase I	Phase II	Phase III
9 months	12 months	up to 36 months

Down-select between phases. Phase I outputs required for the Phase II application are complete by Month 8; Month 9 is reporting and closeout. All awards under this program start and end together.

Phase I milestones and gates

Month 3	Kickoff briefing to DOE/NETL and Gate 1: investigation complete, baselines set
Month 5	Measurement requirements report; candidate data sufficiency check (2 to 3 shortlisted hosts)
Month 6	Preferred host commitment; control and optimization requirements baseline
Month 7	Host integration architecture and interface specification; partner scoping memos
Month 8	Pre-FEED readiness package, Environmental Information Volume, CCUS conceptual design
Month 9	Gate 2: Phase II readiness evidence bundle and Phase I Topical Report

Implementation approach

- Phase I is desk and laboratory work at Zolo plus host screening visits. No unit outage is required.
- Phase III installation of burners, sensing, and controls will be sequenced with the host unit's planned outage schedule. Outage year and season will be fixed in the Phase II FEED.

Management and reporting

- Stage-gate governance under a PMI PMBOK-based process; weekly execution calls, monthly management reviews
- Quarterly progress reports and technical briefings to DOE/NETL per the Federal Assistance Reporting Checklist

Performance Metrics and Risk Management

Success metrics (Phase III demonstration targets)

20% to 50%	Natural gas heat input, stable and continuous co-firing
≤ 1.5%	Net efficiency penalty versus coal-only baseline
20% to 50%	Reduction in SOx, NOx, mercury and CO2 under peak co-firing
2,000 hours	Operational testing, including 1,000 continuous hours at steady state, to validate TRL 8 or higher

Highest-priority risks and mitigations

H **Host legal and procurement delays to commitment or data access**

Mitigation: Multiple candidate hosts, tiered commitment artifacts, early engagement with host legal

H **Down-select schedule: technical outputs due by Month 8**

Mitigation: Front-load screening data and interface definitions; gate-based execution; Month 9 reserved for closeout

H **Host control and measurement tag availability**

Mitigation: Defined minimum host screening data package; explicit data gap list; minimum viable interface

M **CCUS conceptual design scope or assumption misalignment**

Mitigation: Define battery limits and assumptions from Phase I baseline data and the validated co-firing envelope

M **Multi-partner coordination on deliverable definitions and timing**

Mitigation: Weekly execution calls, acceptance criteria per deliverable, internal quality review before submission

H = high, M = medium (overall rating after probability and impact). Risk register reviewed weekly, updated monthly.

Acknowledgment and Disclaimer

Acknowledgment

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