CHP Integrated with Packaged Boilers

EE0004354

CMCE, Inc. and Altex Technologies Corporation

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U.S. DOE Industrial Distributed Energy Portfolio Review Meeting

Washington, D.C.

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ALTEX TECHNOLOGIES

CMC-Engineering

EXECUTIVE SUMMARY

- Surveyed Boiler OEM Designs for Key Burner Retrofit Features
- Developed BBEST Design Specifications to Address Population
- Developed Engineering and Target Specifications
- Developed PI&D and Key Component Designs
- Engineered Microturbine Changes for Simple Cycle
- Engineered and Designed Integrated Burner-Microturbine Package
- Engineered and Designed New Ultra Low NOx Combustor
- Developed Integrated Control Logic and Initiated Procurement
- Executed Purchase of Microturbine and Auxiliary Components
- Expanded Test Laboratory with New Firetube Boiler for Lab Testing
- Secured Host Site in California
- Initiated Fabrication of BBEST Components

PROJECT OBJECTIVE

- *Engineer, Design, Fabricate, and Field Demonstrate a Boiler-Burner-Energy System Technology (BBEST) to Replace Conventional Low NOx Burners on Packaged Boilers (5-50 MMBtu/hr)*
- BBEST: Integration of a 100 kW Simple Cycle Microturbine with an Ultra Low NOx Burner into one Assembly with Integrated Controls
  - CARB 2007 CHP Compliance
  - 9-ppm NOx Boiler Compliance
  - 3,800 Btu/kWh Heat Rate with Corresponding Reductions in CO_2 by 0.18-0.64 tons/MWh (0.40 tons/MWh average)
  - Integrated Boiler and Microturbine Controls
  - Improved Boiler Efficiency Compared to Conventional 9-ppm Burners
  - Reliability on Par with Conventional Burners
  - Other Synergistic Benefits for Boiler Operation

STATE OF ART: CONVENTIONAL DG

- Problem: Today's CHP Focuses on Power *First*
  - Difficult Market Entry
  - Limited to Niche Markets

Where's the thermal load?

Low Quality Waste Heat Recovery with Integrated Heat Exchanger (90 – 140F)

Problems:

- Poor Efficiency (~60%)
- Long Payback (5+)
- Major Finger Pointing
- No Unified Process Controls

STATE OF THE ART: BOILER PROBLEMS

Rising Electricity Prices

Tighter Emission Regulations

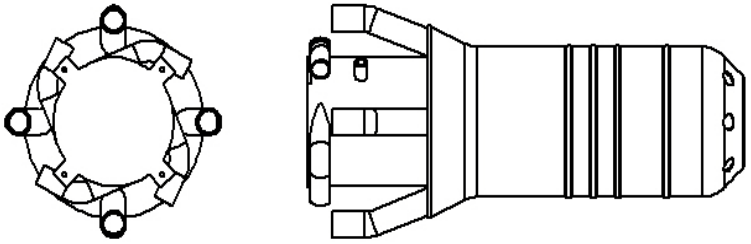
Poor Energy Efficiency

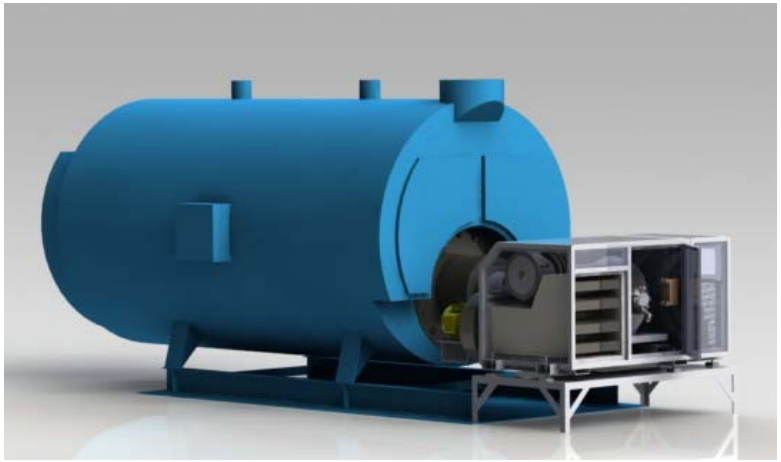
TECHNICAL APPROACH

BBEST Most Cost-Effective Combined Heat and Power CHP System Plug-and-Play Retrofit

Innovations:

- Integrated the Exhaust from a CARB-Compliant Simple Cycle Microturbine with a Commercially Proven Ultra Low NOx Burner
- Operates Like a Conventional Burner that Co-generates Peak Efficiency Power
- Microturbine Flow Energy Recovery to Increase Energy Efficiency
- Low Cost for Quick Payback (<2 yrs)
- Industrial Reliability and User Friendly





TECHNICAL APPROACH

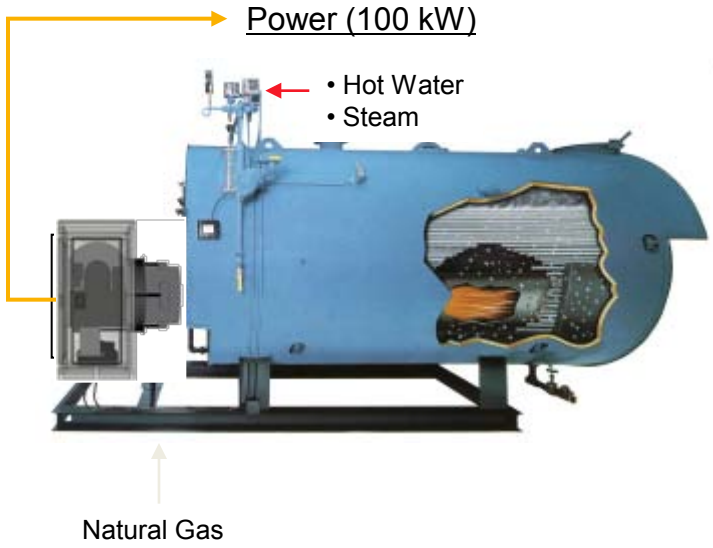
Leadership Positions:

- CHP Experience of CMCE with Commercialization of Altex Burner Technologies

Market Execution:

- Investment into Commercialization
- Securing Key Suppliers of Key Components
- Engineering and Building Proprietary Systems
- Securing Boiler OEM Partnership
- Building Commercial Pipeline
- Securing Industry Representation
- Executing Field Services Agreements

TRANSITION & DEPLOYMENT



- Boilers
- 5-50 MM BTU/hr Firing Rate
- Industrial, Commercial, Municipal
- Population Estimate: 450K worldwide

Industrial


Food


Chemical

Commercial

Hospital


Hotel


Office

Municipal


College


Gov

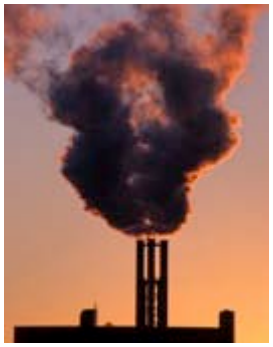
MEASURE OF SUCCESS

Gas-fired Power Plant
40% Efficient

BBEST

	Natural Gas Usage (kW)	
	Before	After
Boiler Blower*	50 kW	0 kW
Electricity (100 kWh)	250 kW	111.3 kW
Total	**300 kW**	**111.3 kW**

Coal-fired Power Plant



85% Less CO_2

63% Less Fuel and CO_2

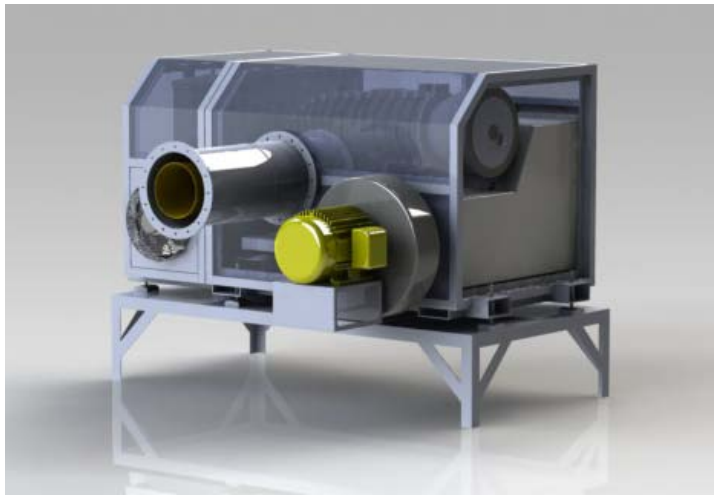
BENEFITS

- ENERGY BENEFITS:
  - 3,000 Btu/kWh savings compared to Modern Central Station; 6,000 Btu/kWh savings compared to Coal Plant
  - Energy savings = (0.5*3,000+0.5*6,000 Btu/kWh)*(net generation of SCMT)*(no of units)* (load factor hrs/yr)
  - ~ 130,000 U.S. Installations == 0.4×10^{15} Btu/yr (0.4 Quads)
- ECONOMIC BENEFITS:
  - Generating Power Cheapest Way Possible @ 2.5 c/kWh ($0.70/therm)
  - $85,000-$120,000/yr savings (electricity and boiler efficiency gains)
- ENVIRONMENTAL BENEFITS:
  - 33 million tons/yr CO_2 Reduction

$$\frac{tons CO_2}{yr} = 10^6 * \left(0.5 * \frac{0.77 lbC}{lbgas} * \frac{lbgas}{23{,}600 Btu} + 0.5 * \frac{0.87 lbC}{lbcoal} * \frac{lbcoal}{12{,}000 Btu} \right) * \frac{44}{12} \frac{0.4 * 10^9 MBtu}{(yr) * 2{,}000 lb / ton} = 33 * 10^6$$

COMMERCIALIZATION APPROACH

- Founded a new company (Leva Energy, Inc.) to commercialize BBEST
- Funded by CMCE, Inc. and Altex Technologies Corporation
- Receiving investor/customer interest (lead funder identified)
- Growing pipeline
- Scale beta unit design to fabricate/manufacture commercial units
- Target high-rate markets where combo of incentive/regulation exists
- Established Supply, Product and OEM channels



PROJECT MANAGEMENT & BUDGET

- Total Project Investment: $2.827 million (incl. 40% cost share)
- Accelerated project timeline to meet NOx compliance mandates in CA, commercialization, and market opportunities
- On track to complete project by 2012 (depending on Host Site)

Task	Completion %	Complete Date
Task 1	15	March 2013
Task 2	50	June 2011
Task 3	60	September 2011
Task 4	10	September 2011
Task 5	10	October 2011
Task 6	0	November 2011
Task 7	0	January 2012
Task 8	0	March 2012

PROJECT MANAGEMENT & BUDGET

Project Budget				
	FY11	FY12	FY13	FY14
DOE Investment	$849,949	$585,316	$250,349	
Cost Share	$251,075	$323,116	$570,199	
Project Total	$1,098,024	$908,432	$820,548	

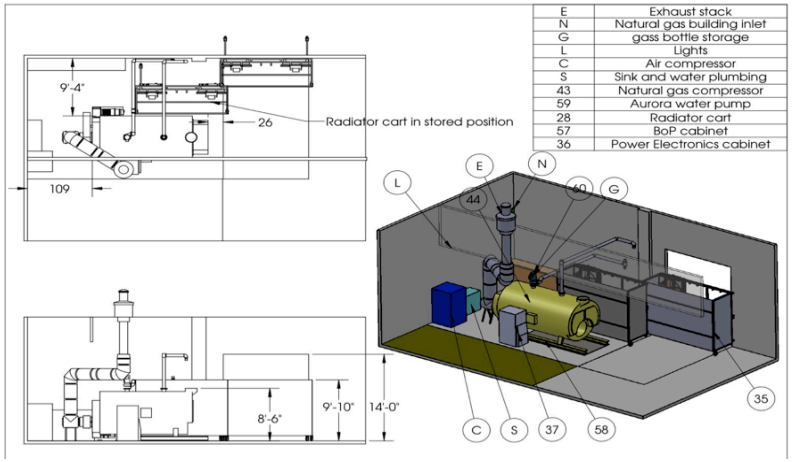
Cost Share Details (approximate):

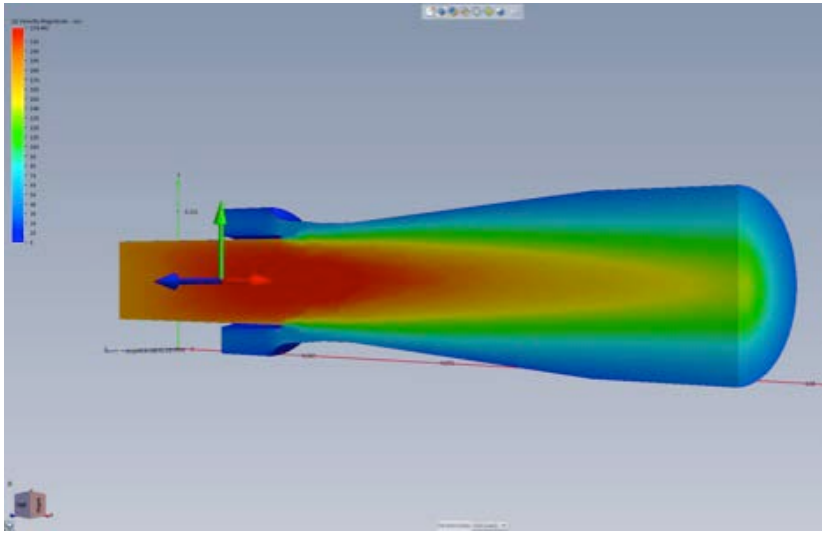
- California Energy Commission: $850,000
- Recipients: $150,000
- Host Site: $114,000

RESULTS & ACCOMPLISHMENTS

Major Accomplishments:

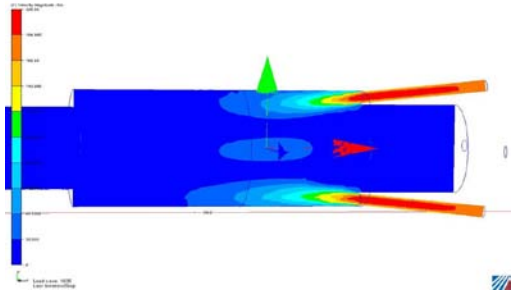
- Secured Key Suppliers
- Finalized Product Design/Footprint
- Performed CFD Testing on Key Components
- Initiated Integrated Control Development
- Building Boiler Test Cell
- Established Boiler OEM Partnerships for Testing/Integration

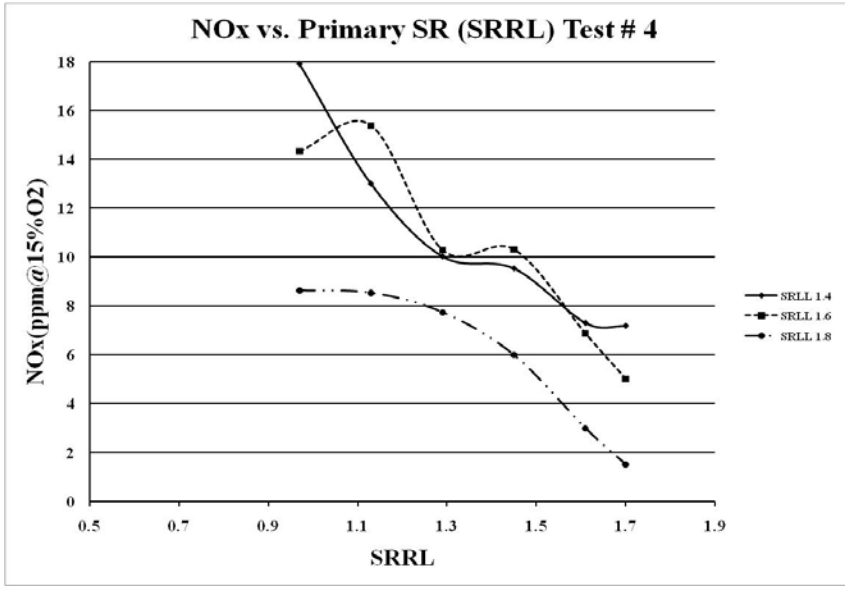




RESULTS & ACCOMPLISHMENT

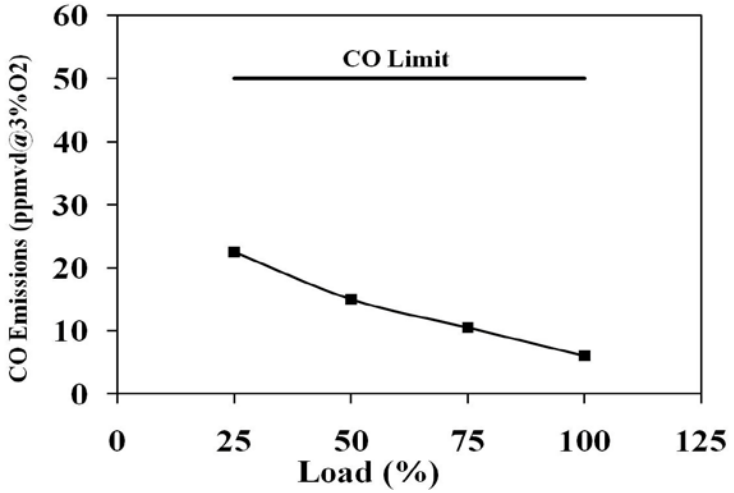
- Combustor Bench Scale Testing Concluded
- Detailed Modeling of Combustor Completed
- Replacement Combustor Designed and Initiated Materials Procurement
- Microturbine Housing Modifications Designed

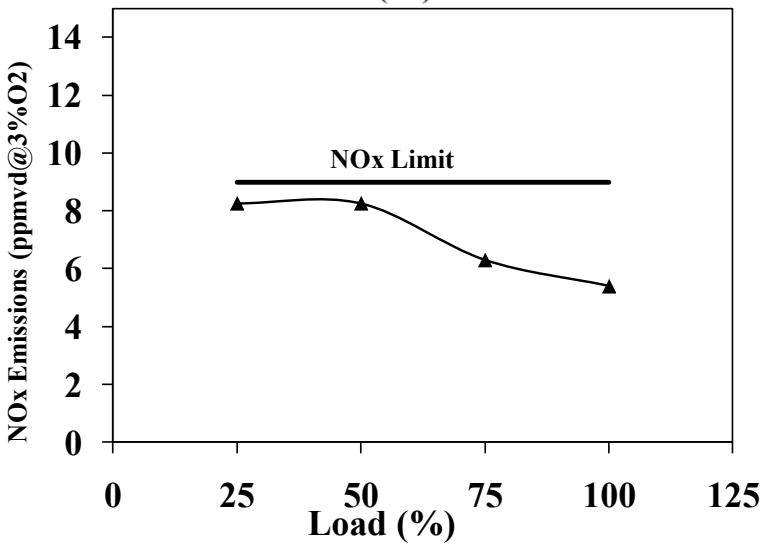




RESULTS & ACCOMPLISHMENT

- CFD Modeling of Integration Concluded
- BBEST P&ID and Dimensions Finalized
- Integrated Burner-Microturbine Control Logic Established
- Burner Operation Matched with Fixed Turbine Exhaust
- Preliminary BBEST Emissions Performance Established at Bench Scale





PATH FORWARD

- Complete Fabrication of Microturbine Combustor / Initiate Testing
- Complete Burner and System Interface Fabrication
- Complete Integrated Burner-Microturbine Controls
- Assemble and Lab Test BBEST on Commercial Boiler
- Optimize System and Components as Necessary
- Install at Host Site
- Perform Field Application Tests
- Finalize Commercialization
- Report Final Results to DOE

QUESTIONS?