

# DoD ESTCP Energy Test Bed Project

EW-201016

## *“High Efficiency – Reduced Emissions Boiler Controls”*

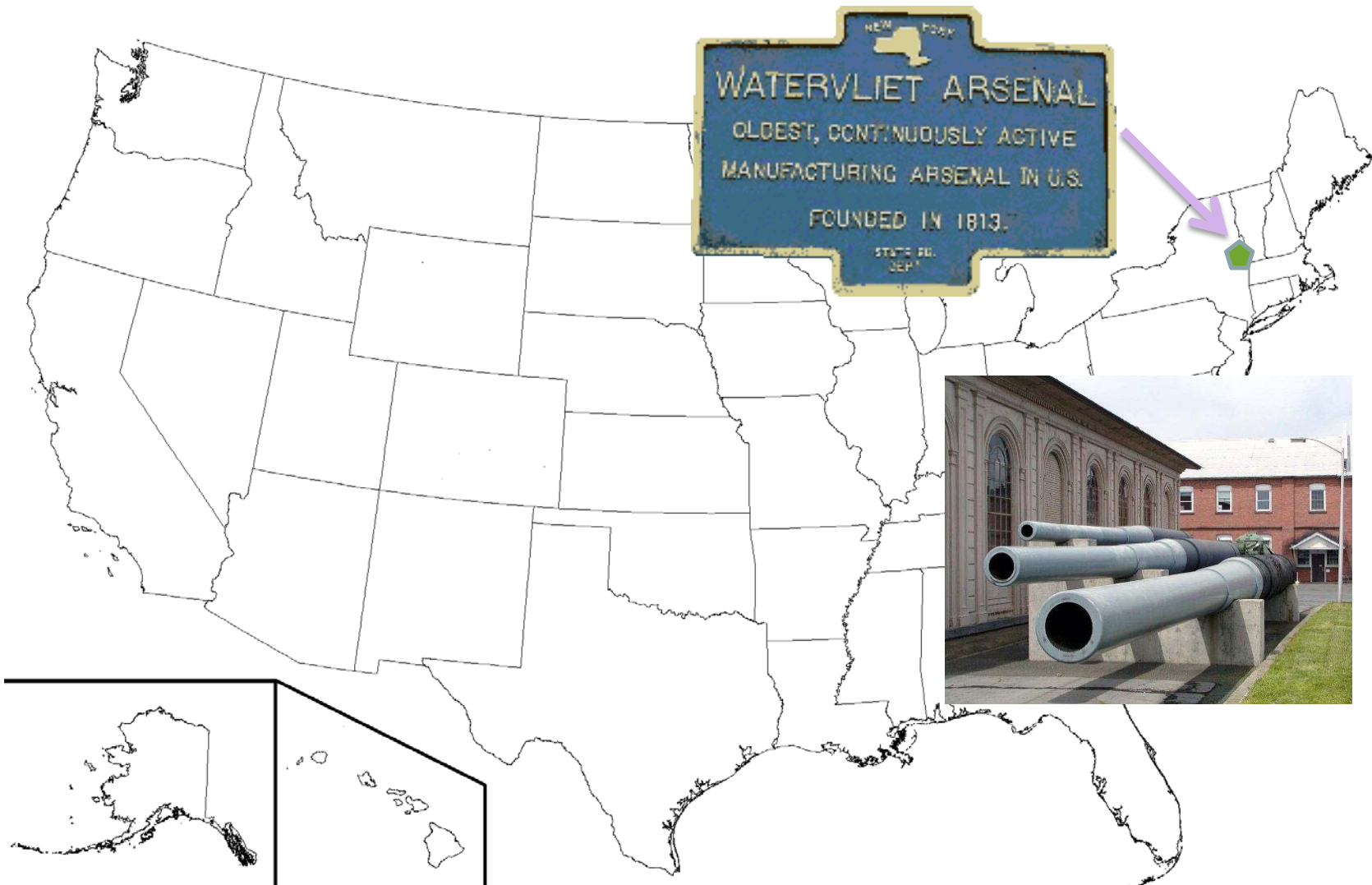
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# ESTCP Energy Test Bed Project Location



# Boiler Efficiency Improvement Demo

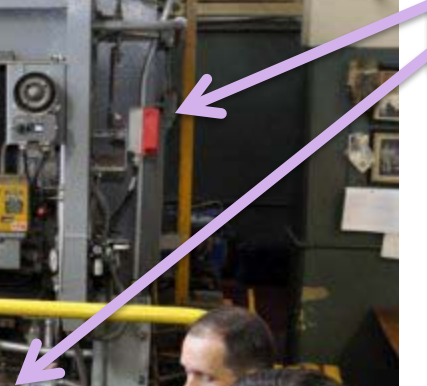
Oxygen  
Sensor



Prototype  
CO  
Sensor



Servo  
Controls



Key  
Findings



- 90% of boilers lack automated controls
- State of the art automated controls sense only oxygen
- Demonstrated prototype sensed oxygen and carbon monoxide

# Boiler Before Demo

- Size: 25 MMBtu
- Age: 30 years
- Fuel: Natural Gas or Oil



- Demo performed by United Technologies Research Center
- Technology demonstrated: Fireeye PPC4000 (Oxygen trim control)
- Upgraded PPC4000 tested as a prototype



# Three Phased Test

- Test Phase 1: Existing Legacy System (baseline)
- Test Phase 2: Installation of O<sub>2</sub> sensor & controls
  - ◆ Fireeye PPC4000
  - ◆ “State of the Art” system
  - ◆ Objective: 5% performance increase above baseline
- Test Phase 3: Addition of CO sensor to Phase 2
  - ◆ Fireeye PPC4000 upgraded with new algorithms
  - ◆ Prototype system upgraded with new sensors
  - ◆ Objective: 6.8% performance increase above baseline

# Test Phase 1: Legacy Boiler Controls



- 90% of boilers lack automated controls

## Test Phase 2: Boiler Controls



- Only about 10% of boilers have automated controls
- Exhaust sensors send signals to servos to adjust fuel/air ratio

# Test Phase 3: O<sub>2</sub>/CO Boiler Controls

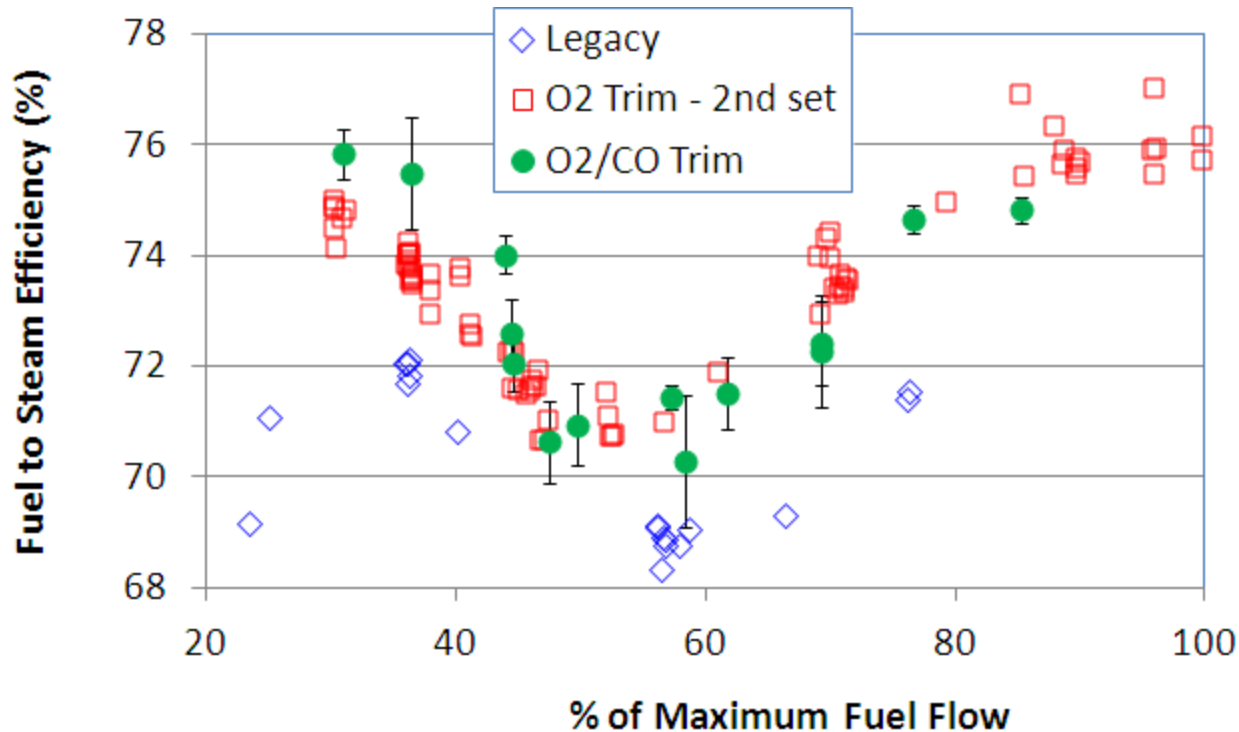


- UTRC tested prototype with advanced algorithms, sensors
- Boiler fully instrumented for accurate energy performance characterization



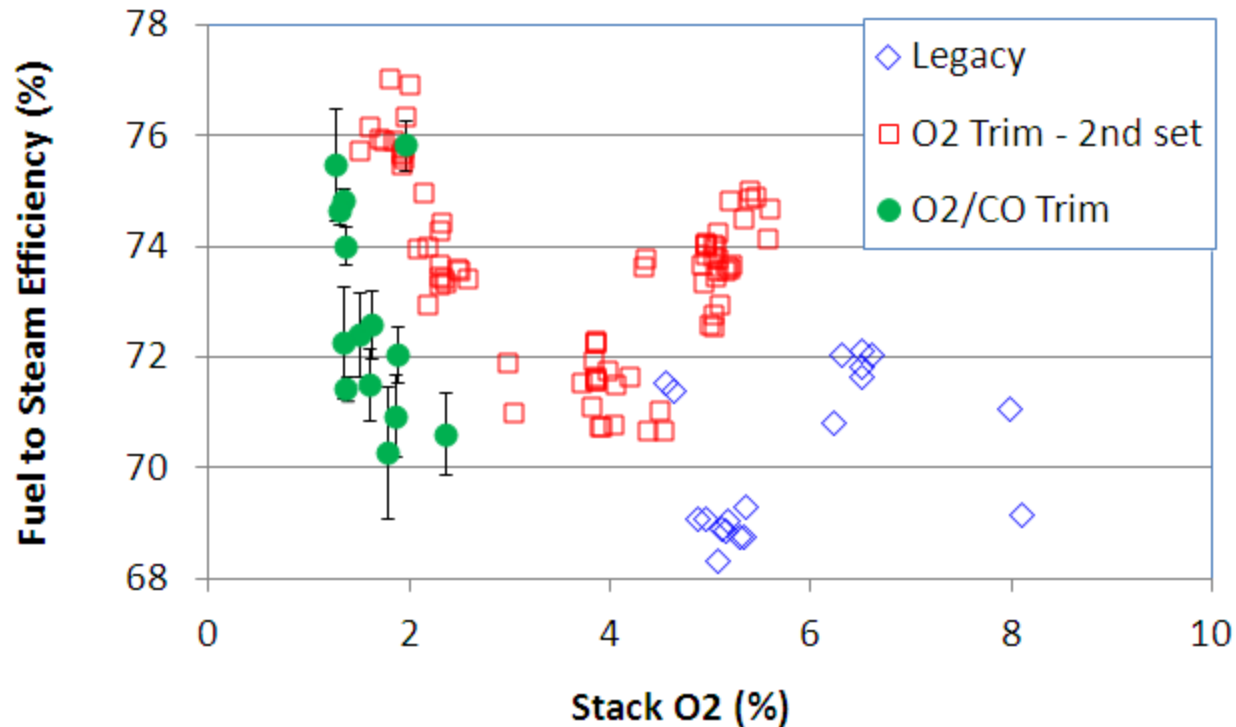


# Results: New technology more fuel efficient



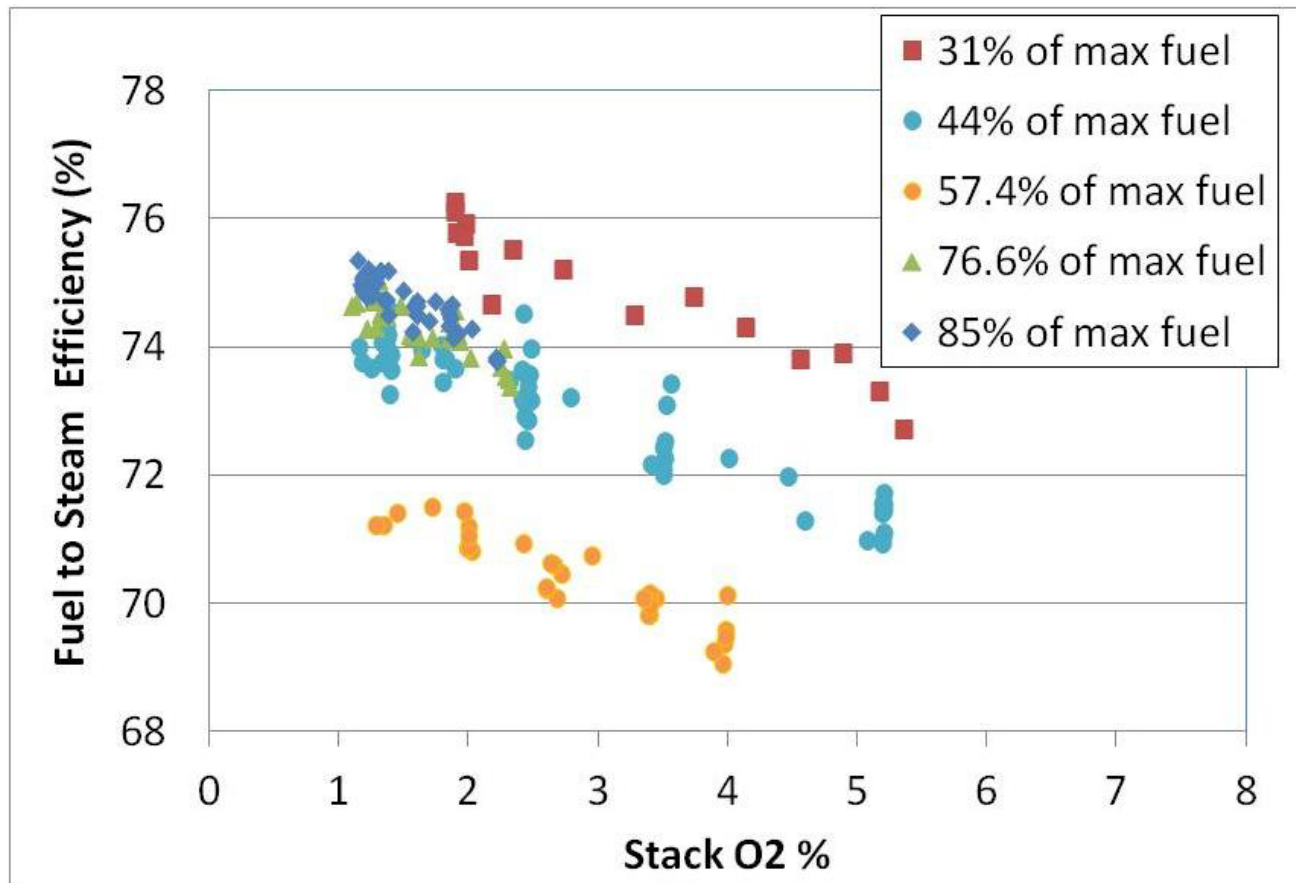
- Green circles: Upgraded PPC4000 prototype – more efficient
- Red boxes: Fireye PPC4000 current technology – more efficient
- Blue diamonds: Mechanically controlled boiler – least efficient

# Results: New Technology exhausts less O<sub>2</sub>



- Green circles: Upgraded PPC4000 prototype – most efficient
- Red boxes: Fireeye PPC4000 current technology – more efficient
- Blue diamonds: Mechanically controlled boiler – least efficient

# Fuel efficiency increases as O<sub>2</sub> levels drop



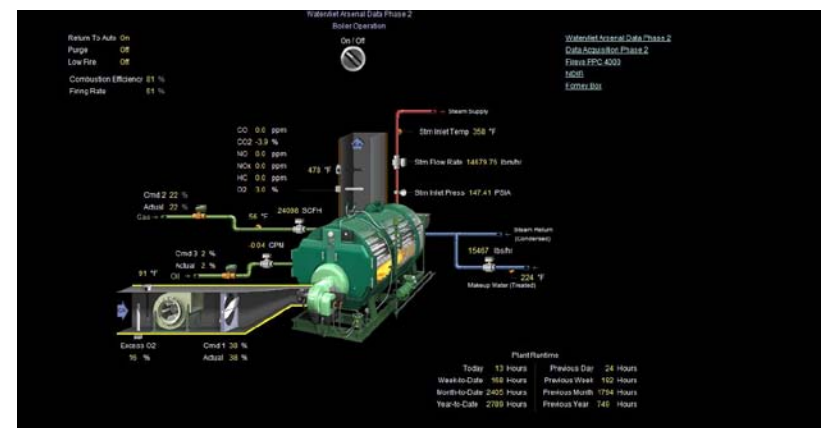
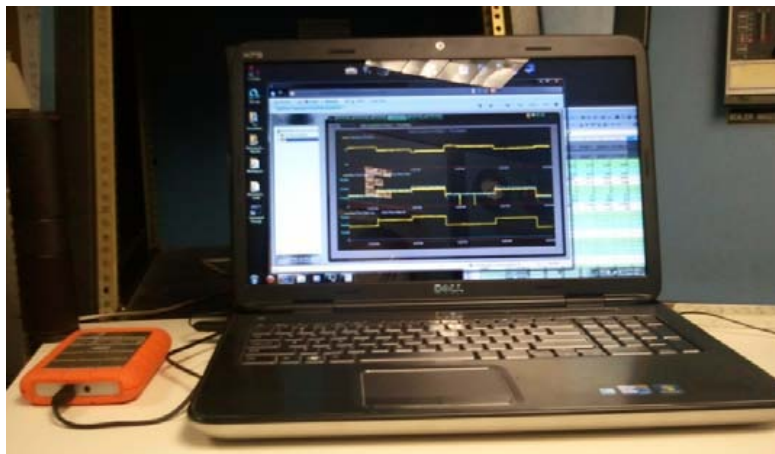
## Potential for the Dept of Defense

- DoD has several hundred boilers for potential combustion control retrofit
- Estimate \$40k to install, 4 days outage, annual maintenance about \$1.5k per boiler
- Price of Natural Gas at Watervliet = \$5.5/MMBtu
- Payback in 2-3 years
- Department-wide savings potential approx \$40M/year with substantial reduction in greenhouse gases
- Potential for several Unified Facilities Criteria adjustment



# Additional Findings

- Larger and oil fueled boilers will have a faster payback.
- Demo system included Graphic User Interface control system
- Prototype needs further development, testing, and certification prior to product release



# Boiler Stats

- Trane Boiler
  - ◆ Size: 25 MMBtu
  - ◆ Age: 30 years
- Technology Provider
  - ◆ United Technologies Corporation
  - ◆ Fireeye
- Control System applies to boilers 10 MMBtu and above
  - ◆ Hot water or steam

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# Back Up Slides



# Installation Energy Roadmap



## Smart Secure Installation Energy Management

- Micro-grids
- Energy Storage
- Ancillary Service Markets



## Efficient Integrated Buildings

- Design, Retrofit, Operate
- Enterprise Optimized Investment
  - Advanced Components
- Intelligent Building Management



## On-Site Distributed Generation

- Cost Effective Renewables
  - Waste to Energy
- Building Integrated Opportunities

# ESTCP Program Goals

- Demonstrate Innovative Cost-Effective Environmental and Energy Technologies
  - ◆ Capitalize on past investments
  - ◆ Transition technology out of the lab
- Promote Implementation
  - ◆ Direct technology insertion
  - ◆ Gain end-user acceptance

 ***Priority: needs of the DoD user community***

# ESTCP Methodology

- Partner With Stakeholders and Test at DoD Facilities
  - ◆ Developer, regulators, end-user
  - ◆ Direct transition
- Validate Operational Cost and Performance
  - ◆ Independent test and evaluation
  - ◆ Satisfy regulatory and user communities
- Identify DoD Market Opportunities
  - ◆ Technology transfer

# Project Requirements

- Formal Demonstration Plans
  - ◆ Independent review
- Execution of Technology Demonstration
  - ◆ Collect cost and performance data
- Written Reports on Cost and Performance
  - ◆ Technical report
  - ◆ Cost and performance summary report
- Support for Transition
  - ◆ Regulatory and end-user acceptance
  - ◆ Guidance and training

