

# Energy Audits: From Clipboard to Cloud

December 18, 2014



# *SERDP & ESTCP Webinar Series*

## Welcome and Introductions

Jennifer Nyman, Ph.D., P.E.  
Webinar Coordinator



# Webinar Agenda

- Webinar Overview and ReadyTalk Instructions  
Dr. Jennifer Nyman, PE, Geosyntec (5 minutes)
- Overview of SERDP and ESTCP, and webinar series goals  
Dr. Jim Galvin, SERDP and ESTCP (5 minutes)
- Introduction to the Topic  
Scott Clark, PE, HydroGeologic (5 minutes)
- simuwatt Energy Auditor, an Electronic Auditing Tool with Geometry Capture  
Oliver Davis, concept3D (25 minutes + Q&A)
- Rapid Building Assessment for Energy Efficiency in the Department of Defense  
Cara Brill, FirstFuel Software (25 minutes + Q&A)
- Final Q&A session

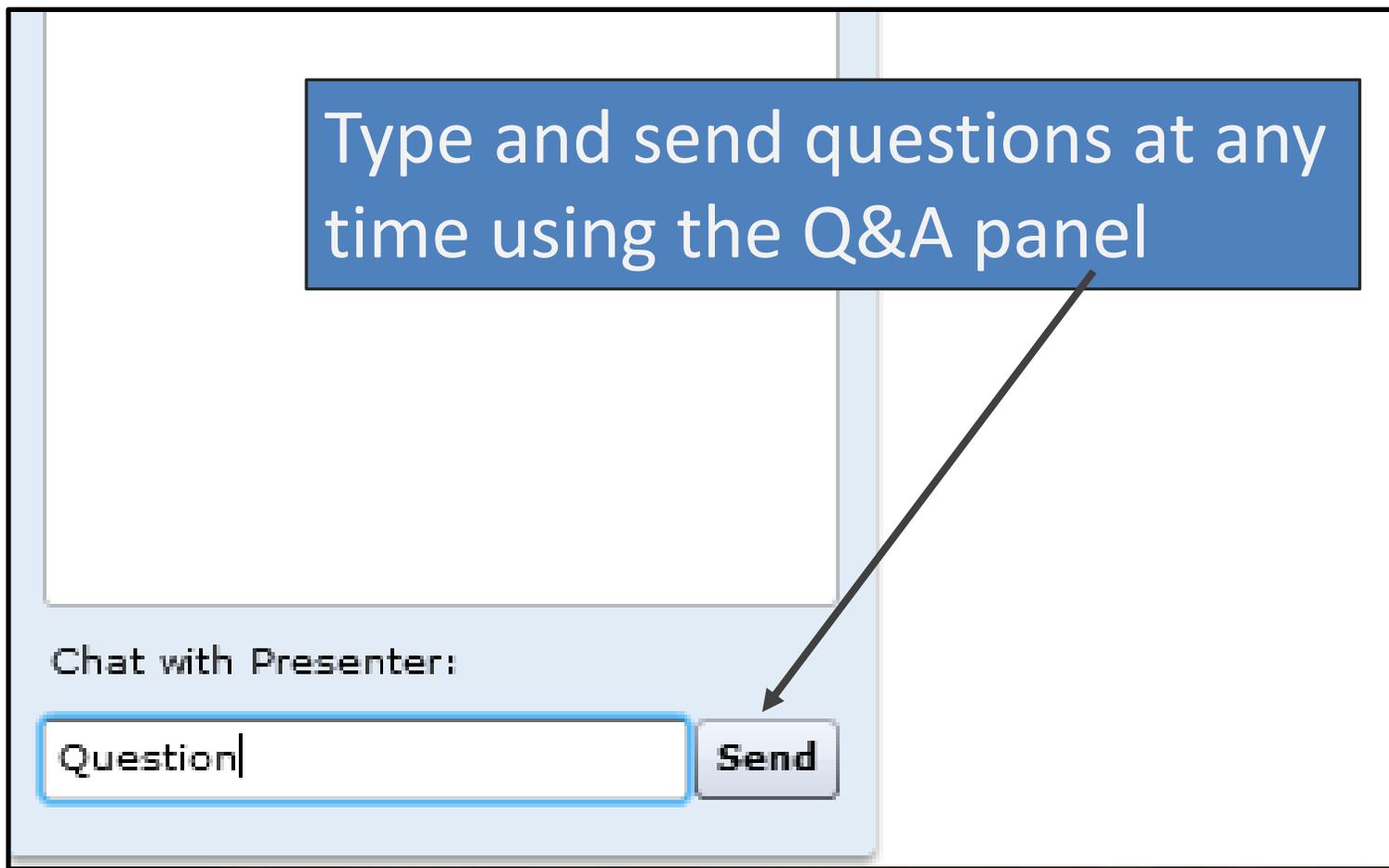
# *SERDP & ESTCP Webinar Series*



## Instructions

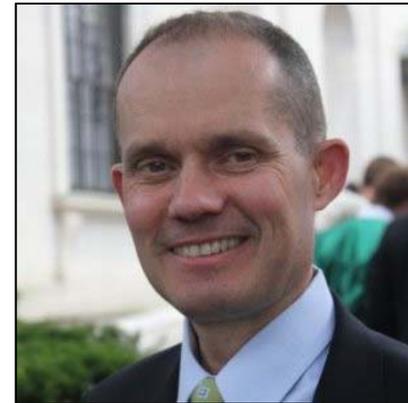


# How to Ask Questions



# SERDP and ESTCP Overview

Jim Galvin, Ph.D.  
Energy & Water  
Program Manager



# SERDP

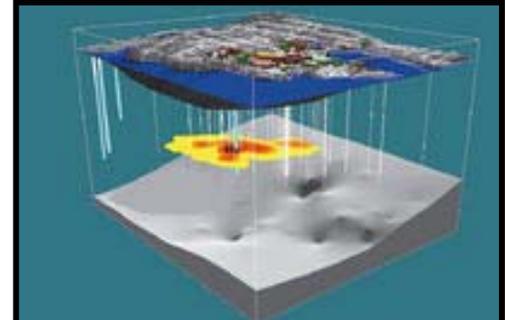
- Strategic Environmental Research and Development Program
- Established by Congress in FY 1991
  - DoD, DOE and EPA partnership
- SERDP is a requirements driven program which identifies high-priority environmental science and technology investment opportunities that address DoD requirements
  - Advanced technology development to address near term needs
  - Fundamental research to impact real world environmental management

# ESTCP

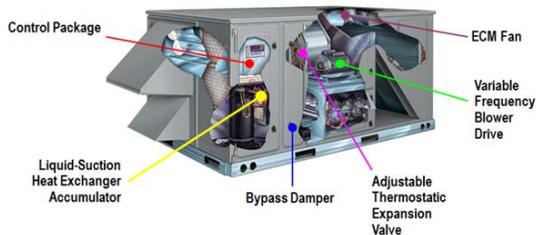
- Environmental Security Technology Certification Program
- Demonstrate innovative cost-effective environmental and energy technologies
  - Capitalize on past investments
  - Transition technology out of the lab
- Promote implementation
  - Facilitate regulatory acceptance

# Program Areas

1. Energy and Water
2. Environmental Restoration
3. Munitions Response
4. Resource Conservation and Climate Change
5. Weapons Systems and Platforms



# Energy and Water



- Smart and Secure Installation Energy Management
  - Microgrids
  - Energy Storage
  - Ancillary Service Markets
- Efficient Integrated Buildings and Components
  - Design, Retrofit, Operate
  - Enterprise Optimized Investment
  - Advanced Components
  - Intelligent Building Management
  - Non-Invasive Energy Audits
- Distributed Generation
  - Cost Effective
  - On-Site
  - Emphasis on Renewables

# SERDP and ESTCP Webinar Series

DATE	WEBINARS AND PRESENTERS
January 8, 2015	<b>DNAPL Source Zone Management</b> <ul style="list-style-type: none"><li>• Dr. Paul Johnson (Arizona State University)</li><li>• Dr. Charles Newell (GSI Environmental)</li></ul>
January 22, 2015	<b>Sustainable Materials</b> <ul style="list-style-type: none"><li>• Dr. Andrew Guenther (Air Force Research Laboratory, Aerospace Systems Directorate)</li><li>• Dr. Benjamin Harvey (Naval Air Warfare Center, Weapons Division)</li><li>• Dr. John La Scala (U.S. Army Research Laboratory)</li></ul>
February 5, 2015	<b>Acoustic Methods for Underwater Munitions</b> <ul style="list-style-type: none"><li>• Dr. Joseph Bucaro (Naval Research Laboratory)</li><li>• Dr. Kevin Williams (APL University of Washington)</li></ul>
February 19, 2015	<b>Solar Technologies</b>

# *SERDP & ESTCP Webinar Series*

<http://serdp-estcp.org/Tools-and-Training/Webinar-Series>



# *SERDP & ESTCP Webinar Series*

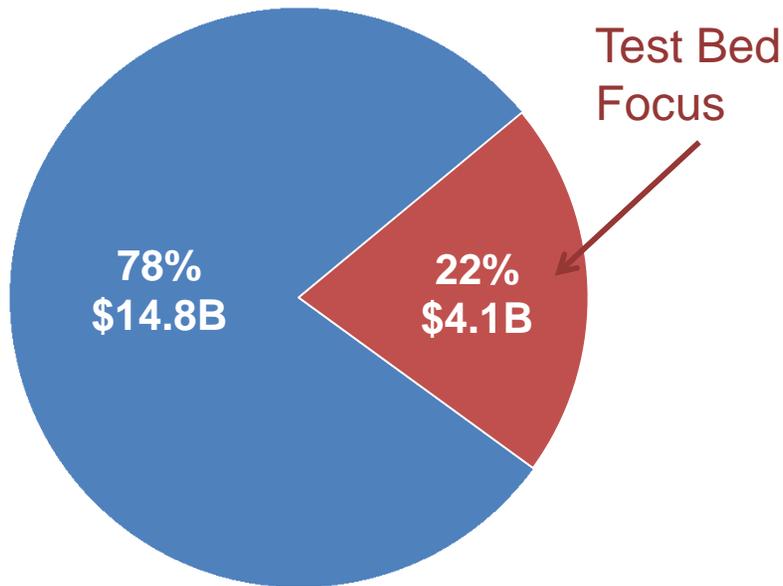
## Introduction to the Topic

Scott Clark, P.E.  
Senior Energy Engineer  
HydroGeoLogic, Inc.

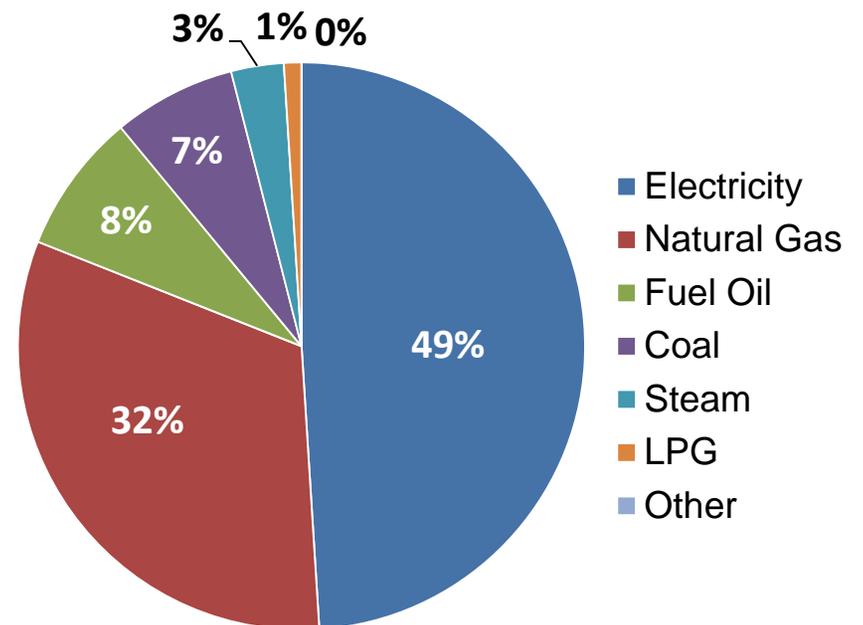


# DoD Energy Use, FY 2013

DoD Facility & Operational Energy  
Cost: \$18.8B



■ Operational Energy   ■ Facility Energy



Military  
Installation  
Energy Usage

# Why Audit?

- EISA 2007 requires audits of covered spaces once every four years.
- To be effective, managing energy should be given the same emphasis as any other cost/profit center

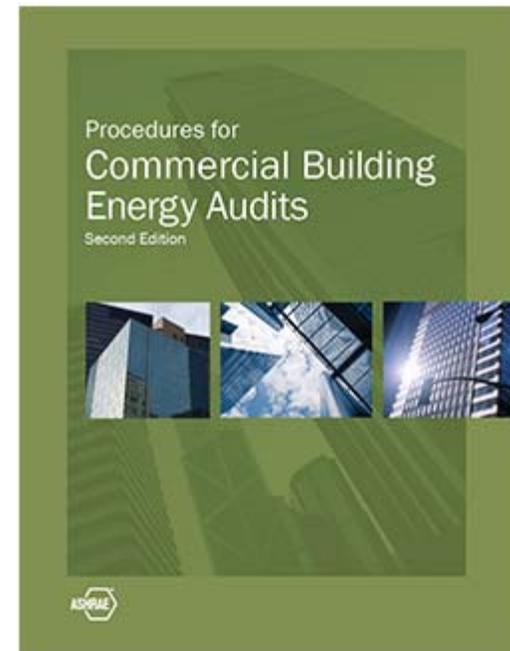


# Audit Benefits

- No-cost adjustments
- Short-term retrofit recommendations
- Action plans for capital investments
- Address comfort and code issues
- Determine opportunities for adherence standards

# Types of Audits

- Most commonly defined by ASHRAE
- Level 1
  - “Walkthrough” Audit
- Level 2
  - Most Common, More detailed analysis, Required for Federal Facilities
- Level 3
  - Investment Grade Audit



# Rules of Thumb

- Time To Complete varies with Level of Audit and Building Size
- Costs vary from \$0.12 up to \$0.50 per square foot
- Generally audits should not exceed 10% of the annual utility bill

# Audit Considerations

- Scope/Level of Detail
- Time
- Costs



# Today's Presentation

- DoD has over 300,000 buildings
- Better, Faster, Cheaper
- Different Approaches, Same Results

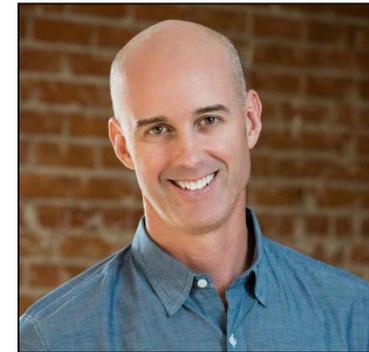
FIRST FUEL  
BUILDING ENERGY ANALYTICS

simuwatt®

# *SERDP & ESTCP Webinar Series*

## simuwatt Energy Auditor, an Electronic Auditing Tool with Geometry Capture

Oliver Davis  
concept3D



# *SERDP & ESTCP Webinar Series*

Superior building energy audits in a fraction of the time with simuwatt™

SERDP/ESTCP EW-201260

Oliver Davis, concept3D



# Agenda

- Background
- ESCTP Project Objective & Results
- simuwatt Overview
- Relevance to DoD
- Conclusions

# Background

- Energy audits are mandated by EISA 2007
  - EISA 2007 represents significant cost to DoD
  - 25% of DoD's 1.9B sqft per year<sup>1</sup>
  - “Requires documented findings of a walk-through survey...”<sup>2</sup>
- High quality audits – effective but expensive
  - No standard for collecting data
  - Non-standard data cannot be aggregated
  - Data cannot be re-used (paper reports)

<sup>1</sup> Final ESTCP Report: Electronic Auditing Tool with Geometry Capture

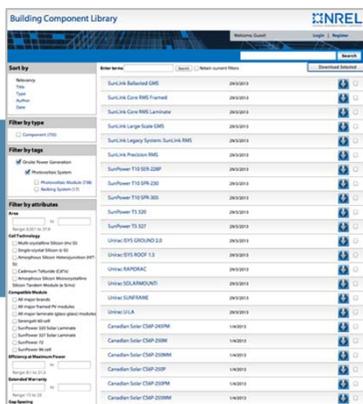
<sup>2</sup> [http://www1.eere.energy.gov/femp/pdfs/draft\\_EISA\\_project\\_guidance.pdf](http://www1.eere.energy.gov/femp/pdfs/draft_EISA_project_guidance.pdf)

# ESTCP Project Objective

NREL Building  
Component Library

Joint Proof  
of Concept

simuwatt  
Level II/III Prototype



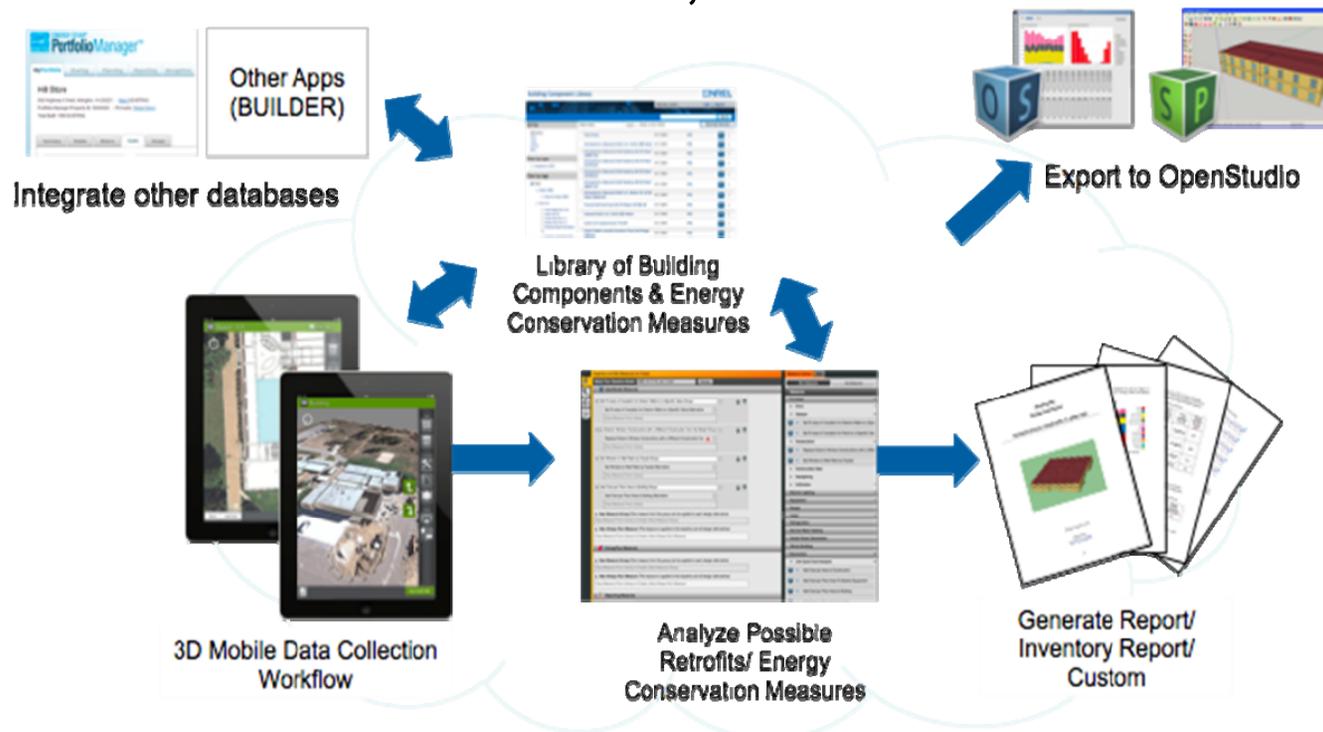
Extensible library  
of components  
and ECM's

Mobile  
geometry and  
data capture

Award to  
develop mobile  
auditing app

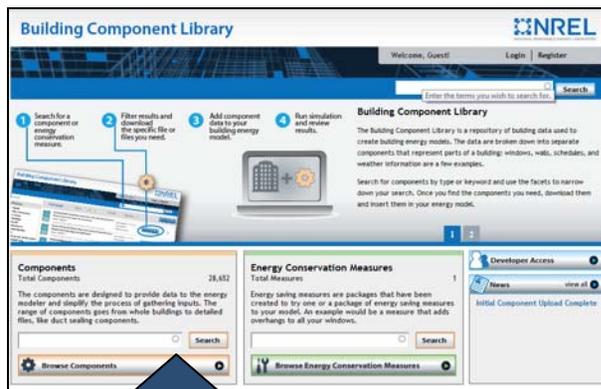
# ESTCP Project Objective

- Demonstrate tablet-based software tool
- Lowers cost of DoD energy audits
- Stores data in consistent, reusable format



# ESTCP Project Results

- Integrate technologies to create mobile audit application



Component IDs

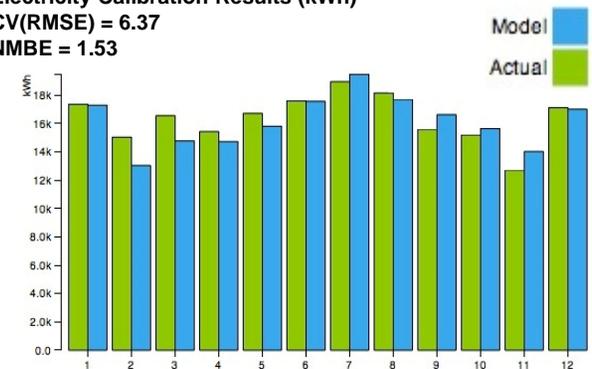
Rapid data collection for building assets



Model Data Definitions

Model Structure

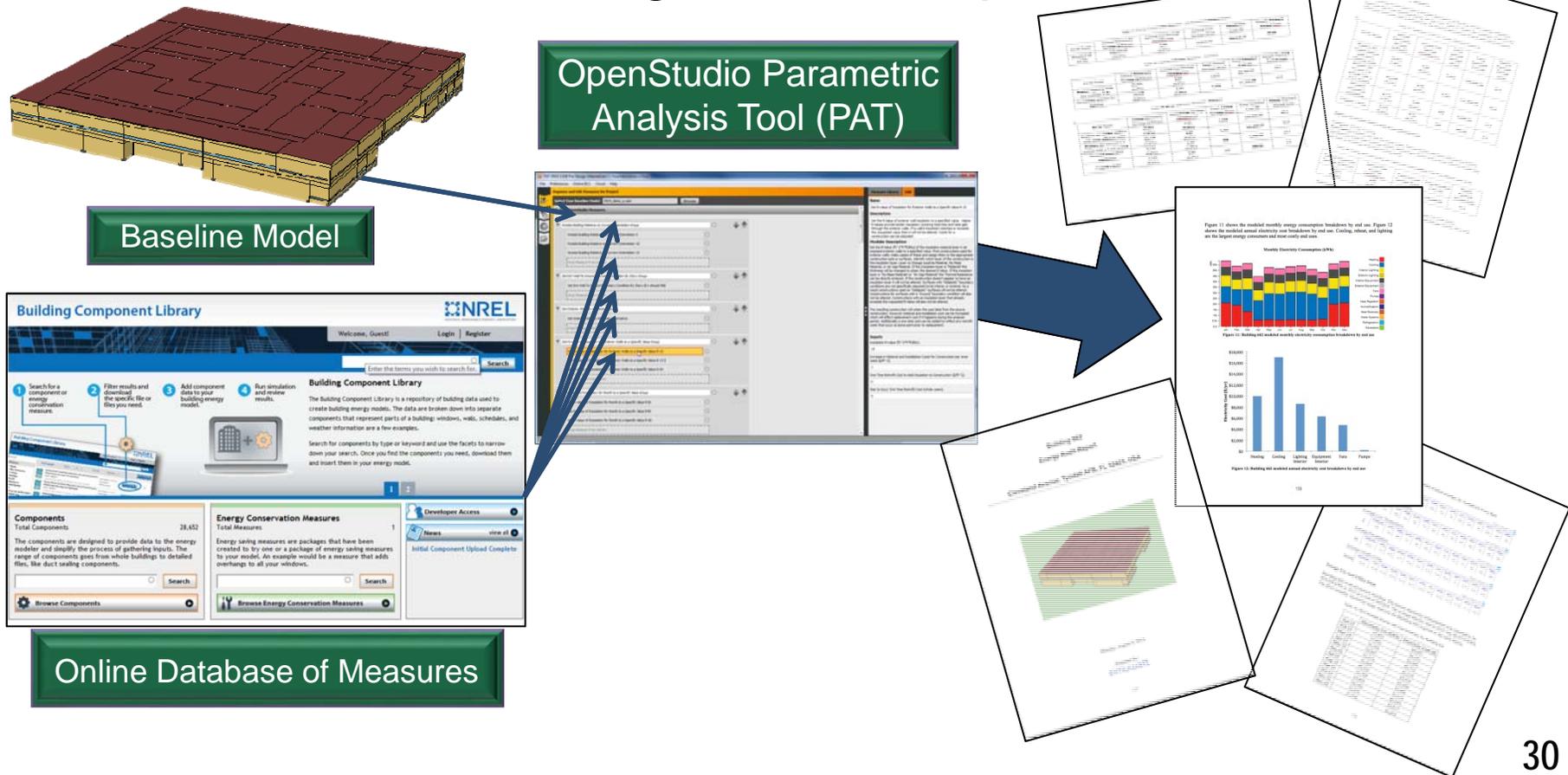
Electricity Calibration Results (kWh)  
 $CV(RMSE) = 6.37$   
 $NMBE = 1.53$



Automated creation of baseline model

# ESTCP Project Results

- Life cycle analysis identifies cost-effective measures
- Documented in auto-generated report



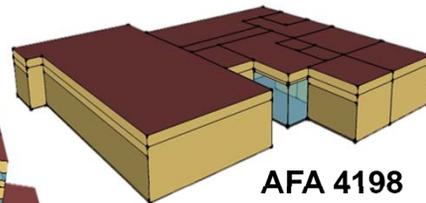
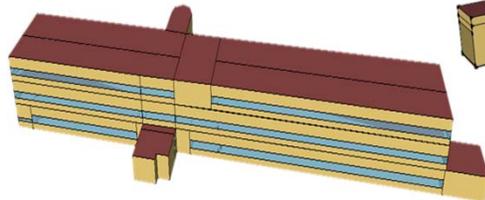
# ESTCP Project Results

- simuwatt produced calibrated models at multiple sites



U.S. AIR FORCE

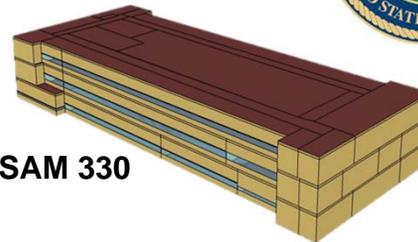
Tyndall AFB 1060



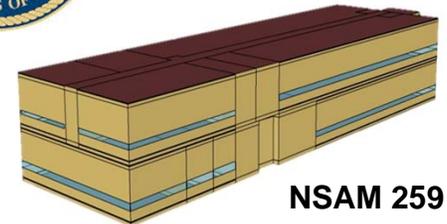
AFA 4198



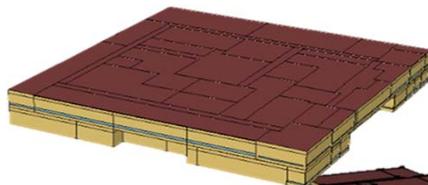
NSAM 330



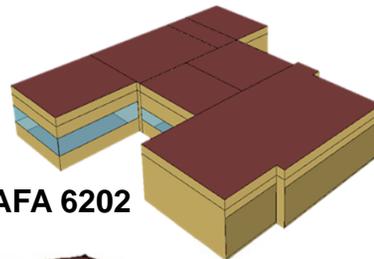
NSAM 259



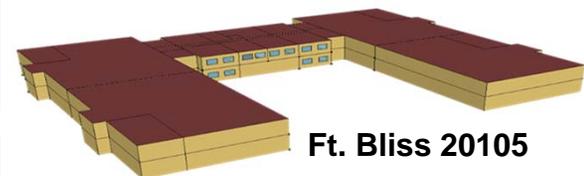
Tyndall AFB 662



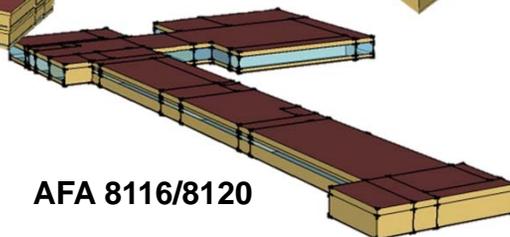
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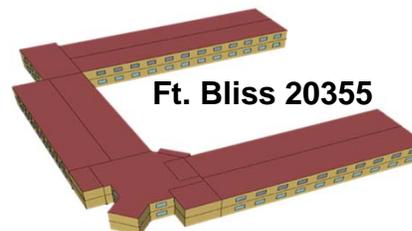
Ft. Bliss 20105



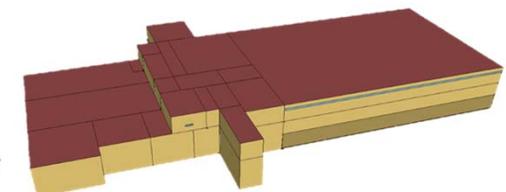
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Ft. Bliss 20107



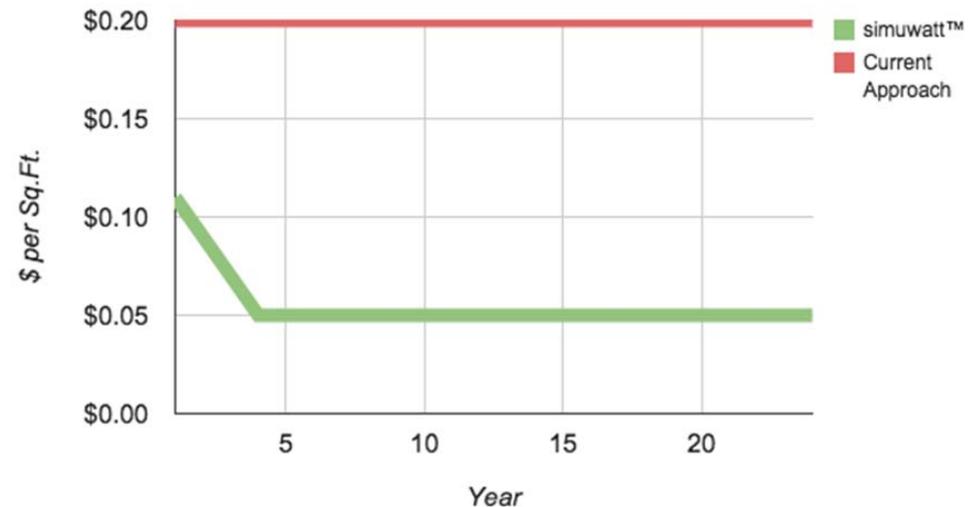
# Case Study: NSAM Building 330

- 75,000 sqft., 3-story building constructed 1969
- Multiple Space Types and uses over its life
  - Offices, classrooms, auditorium, data center, and break rooms
- Benefits and results of simuwatt use:
  - Surveyed and exported energy model in 1 day
  - 5 measures identified, average payback in 3.7 years
  - Savings: 10.1% energy consumption, \$19,789 per year
- Ability to simplify complex building properties:
  - Input equipment and controls
  - Create multiple zones per floor
  - Replicate zones to other floors



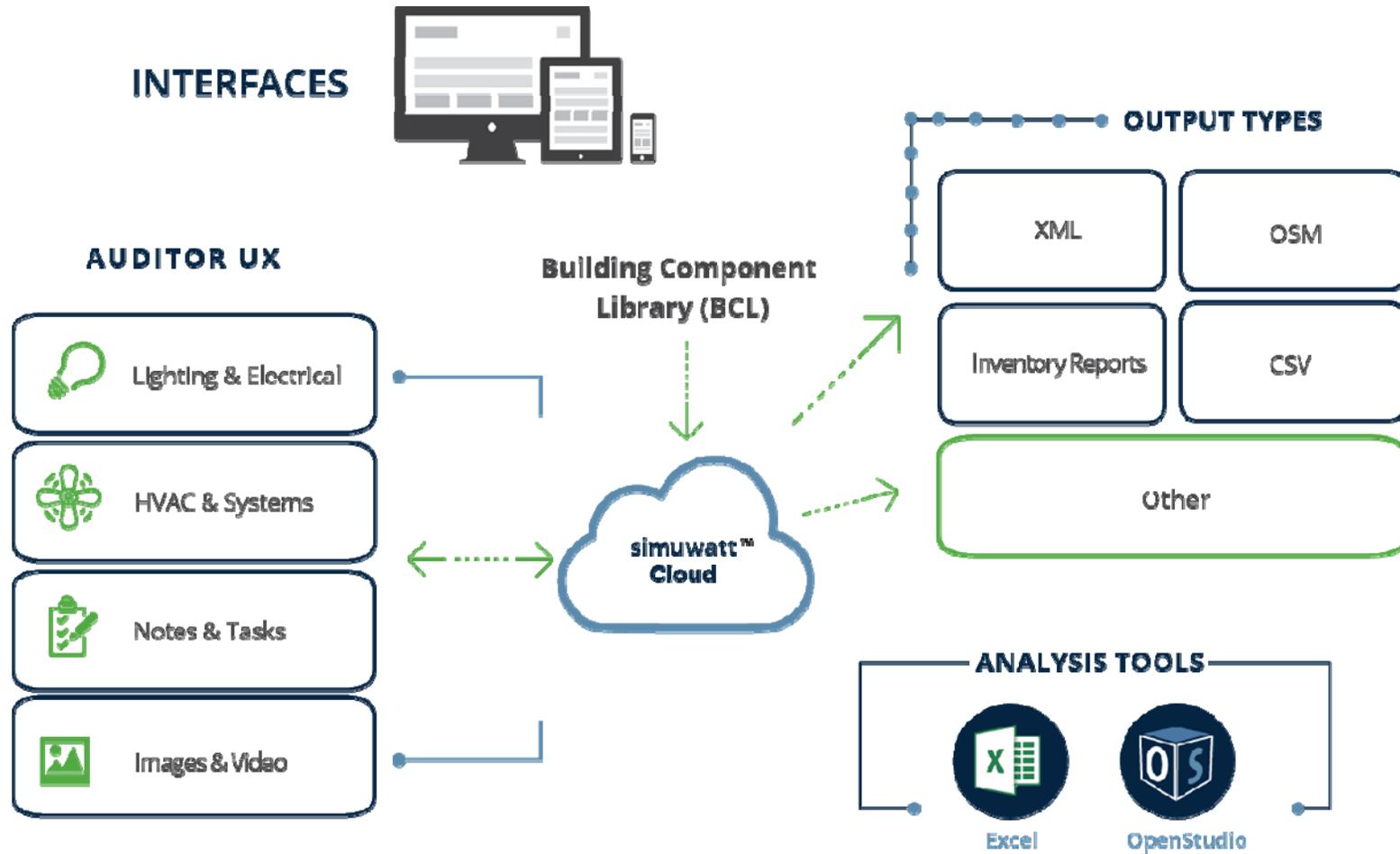
# ESTCP Project Results

- Significant savings over existing audit processes
  - Audits with Air Force, Army and Navy
  - Blind head-to-head study with Tier 1 ESCO
  - 53% savings compared to Level II audits<sup>1</sup>
  - Reused audits capture 75% savings<sup>1</sup>
  - \$1.28B direct cost savings over 25 yrs<sup>1</sup>



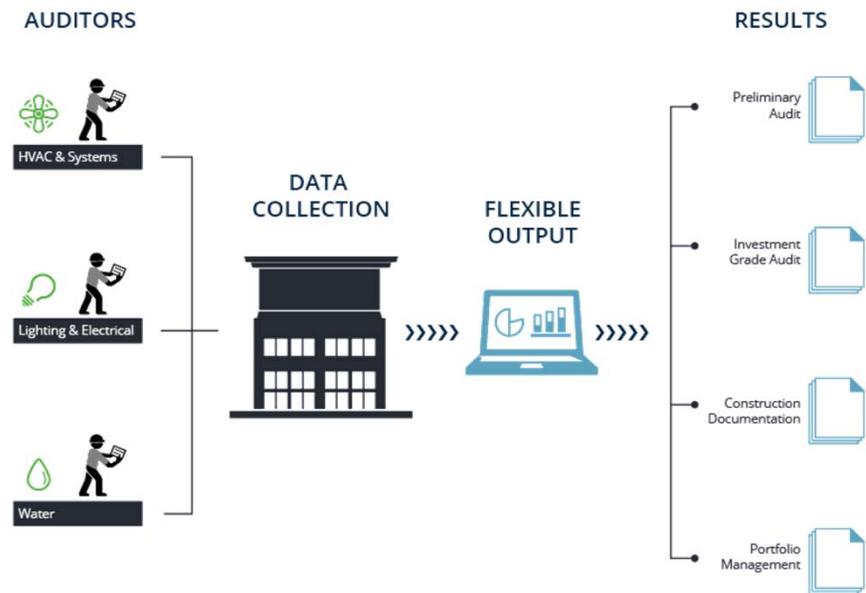
<sup>1</sup>Final ESTCP Report: Electronic Auditing Tool with Geometry Capture

# simuwatt Overview



# Relevant to DoD

- \$1.28B Direct Savings for DoD over 25 Years
- EISA 2007 Section 432 Compliant
- Specific, location-based data for Agency's buildings
- Available for future re-use, actionable results



# Relevance to DoD

- Partnership with NREL
- Agency Interest
  - simuwatt included in INL report to DoE Q4'14
  - Active inquiries: NASA, State Dept., DOI, DOT, USFS, AFCEC, NAVFAC, FEMP
- simuwatt can facilitate 1st Party Audits at DoD

# Conclusions

- ESTCP project with simuwatt & NREL a success
- Mobile application, standardized data collection
- Helps DoD meet EISA 2007 requirements
- 53% savings on audits using simuwatt
- 75% savings on repeat audits

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For additional information, please visit:  
[www.simuwatt.com](http://www.simuwatt.com)

Speaker Contact:

Oliver Davis, [Oliver@concept3D.com](mailto:Oliver@concept3D.com) 720.239.2898



# *SERDP & ESTCP Webinar Series*

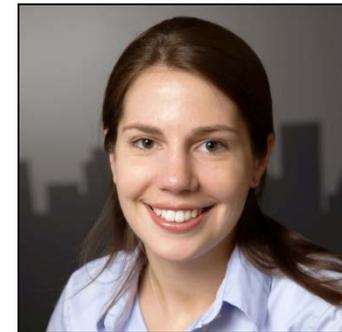
## Q&A Session 1



# *SERDP & ESTCP Webinar Series*

## Rapid Building Assessment for Energy Efficiency in the Department of Defense

Cara Brill  
FirstFuel Software



# *SERDP & ESTCP Webinar Series*

## Rapid Building Assessment for Energy Efficiency in the Department of Defense

SERDP/ESTCP Project Number EW-201261,  
Cara Brill  
Project Manager, FirstFuel Software

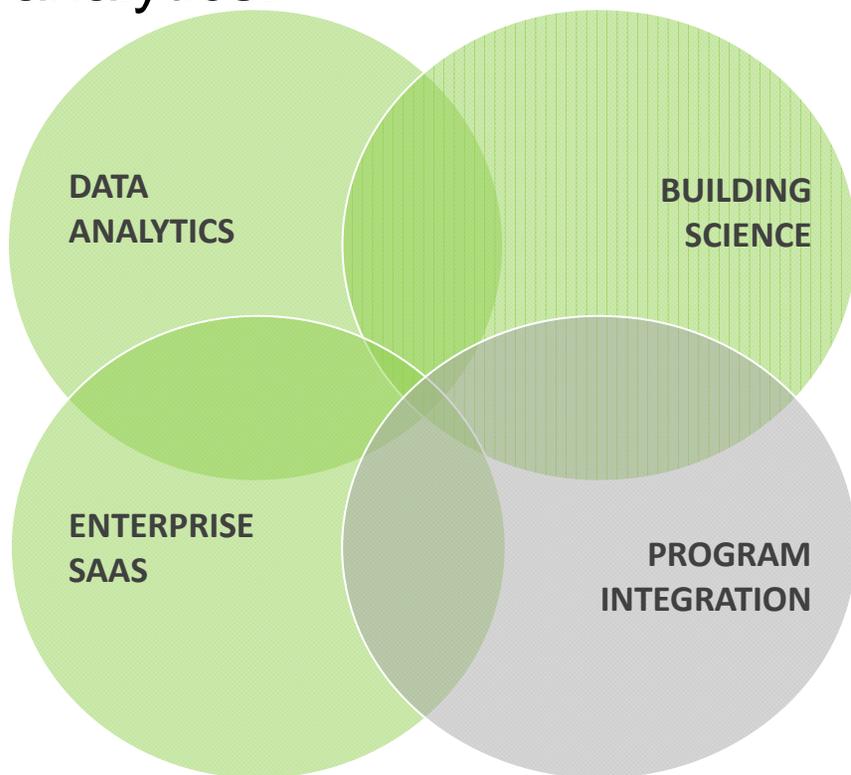


# Agenda

- What is FirstFuel Software?
- Analytics-Enabled Energy Efficiency
- DoD/ESTCP Project Overview
- Audit Findings and Outcomes
- Fort Bliss: A Case Study
- Lessons Learned
- Conclusion

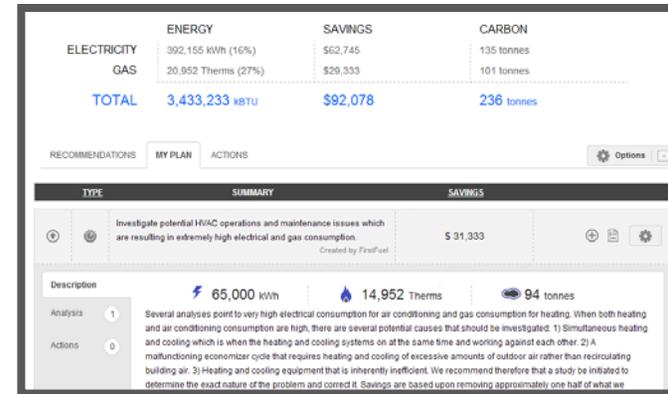
# FirstFuel Is an Energy Intelligence Company

Harnessing the power of customer meter data to accelerate and scale commercial energy efficiency via ‘zero-touch’ analytics.



- Deployed at over 20 large utilities and government agencies
- Innovative energy management programs which help our customers efficiently identify and realize energy savings goals

# Analytics Across the Lifecycle of Efficiency

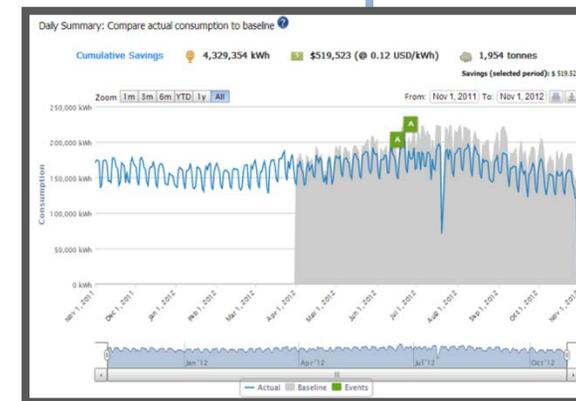
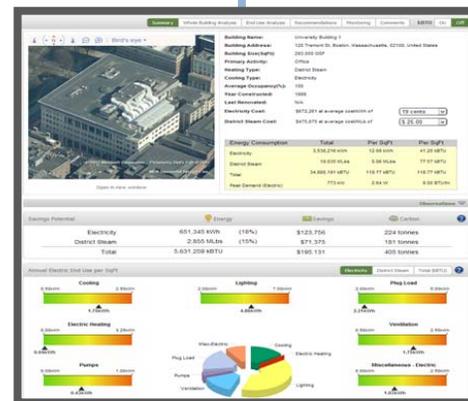


**SCREEN PORTFOLIO**

**CONDUCT REMOTE AUDITS**

**ENGAGE AND IMPLEMENT**

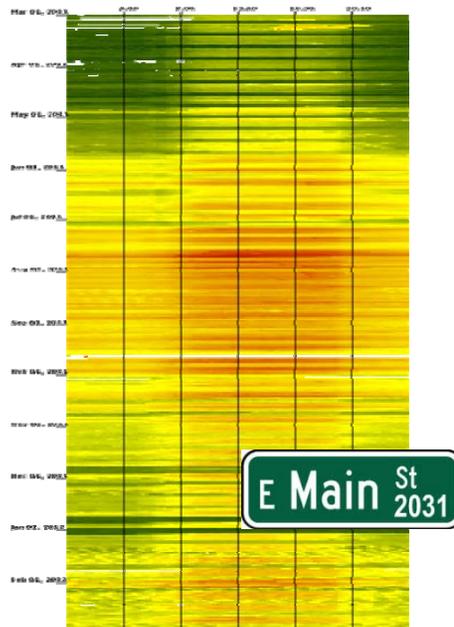
**MONITOR SAVINGS**



# Key to Accelerating KWH/KW Savings:

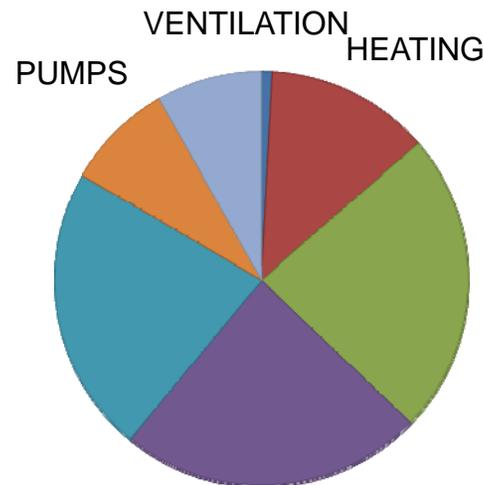
## Understand the Unique Story of Every Building

### 1 MINIMAL DATA INPUTS



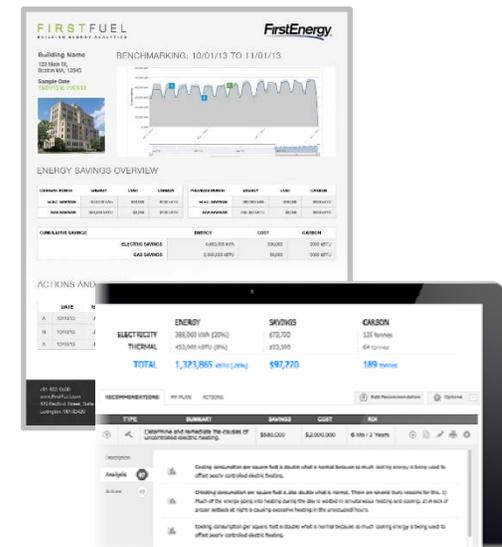
No onsite visits or devices.

### 2 ENERGY INTELLIGENCE



No building simulations or buildings “like” this one.

### 3 CUSTOMER-SPECIFIC COMMUNICATION



Unique, verified analysis and messages for each building

# Assess Energy Analytics Across Diverse Portfolio

- **Department of Defense** was challenged with identifying and profiling energy savings opportunities across their large and diverse portfolio
- 5 Building Types unique to DOD analyzed :
  - Type 1 – Headquarters, classroom buildings
  - Type 2 - Barracks, dining facilities
  - Type 3 - Warehouses, Commissaries
  - Type 4 - Rec centers, auditoriums
  - Type 5 - Facilities with lighter process loads

## DEMONSTRATION PROJECT SCOPE

**100** DoD Buildings Analyzed

**11** Different DoD Installation Bases

**5** Different Building Types



# Program Performance Objectives

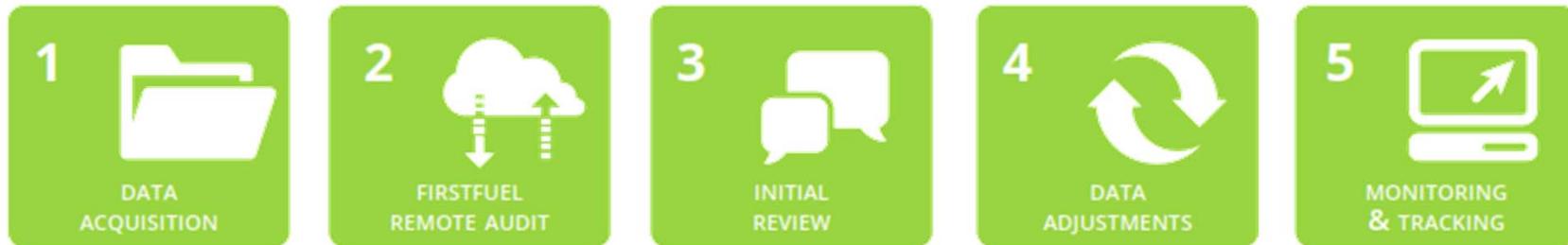
- FirstFuel Software’s ESTCP Demonstration Project tested FirstFuel’s analytics platform against three performance objectives: **Cost, Accuracy, and Scalability**

Performance Objective	Metric	Success Criteria
<b>Cost</b>	FirstFuel Remote audit price per building and per square foot	<ul style="list-style-type: none"> <li>The average cost for the FirstFuel Audits performed on the 16 ASHRAE<sup>1</sup> Level II audited buildings (Types 1-5) will be less than or equal to \$3,000/building, or \$0.12/square foot (whichever is higher)</li> </ul>
<b>Scalability</b>	Hours per engineer per FirstFuel remote audit	<ul style="list-style-type: none"> <li>FirstFuel Audits for Type 1 buildings completed in 75% of the time of onsite ASHRAE LII Audits.</li> <li>FirstFuel Audits for Type 2-5 completed in 50% of the time of onsite ASHRAE LII Audits.</li> </ul>
<b>Accuracy</b>	<ul style="list-style-type: none"> <li># of Recommendations identified</li> <li># of ASHRAE Level II recommendations</li> </ul>	<ul style="list-style-type: none"> <li>RBA finds 80% of the recommendations found in Building Type 1 ASHRAE LII audits.</li> <li>RBA finds 60% of the recommendations found in Building Types 2-5</li> <li>RBA finds recommendations NOT found in Type 1 Building ASHRAE LII onsite audits.</li> </ul>

<sup>1</sup> ASHRAE is an organization that develops standards for the design and maintenance of indoor environments.

# Remote Energy Audit Delivery Process

## FIRSTFUEL REMOTE ENERGY AUDIT DELIVERY



FirstFuel requires:

- 1 year of interval consumption data
- Building address
- Short building survey (optional)

FirstFuel adds weather, GIS, and other inputs to perform the analysis. Results are placed on branded web portal

FirstFuel engineer reviews results with building stakeholders via Efficiency Planning webinar

Analysis may be updated based on webinar discussion

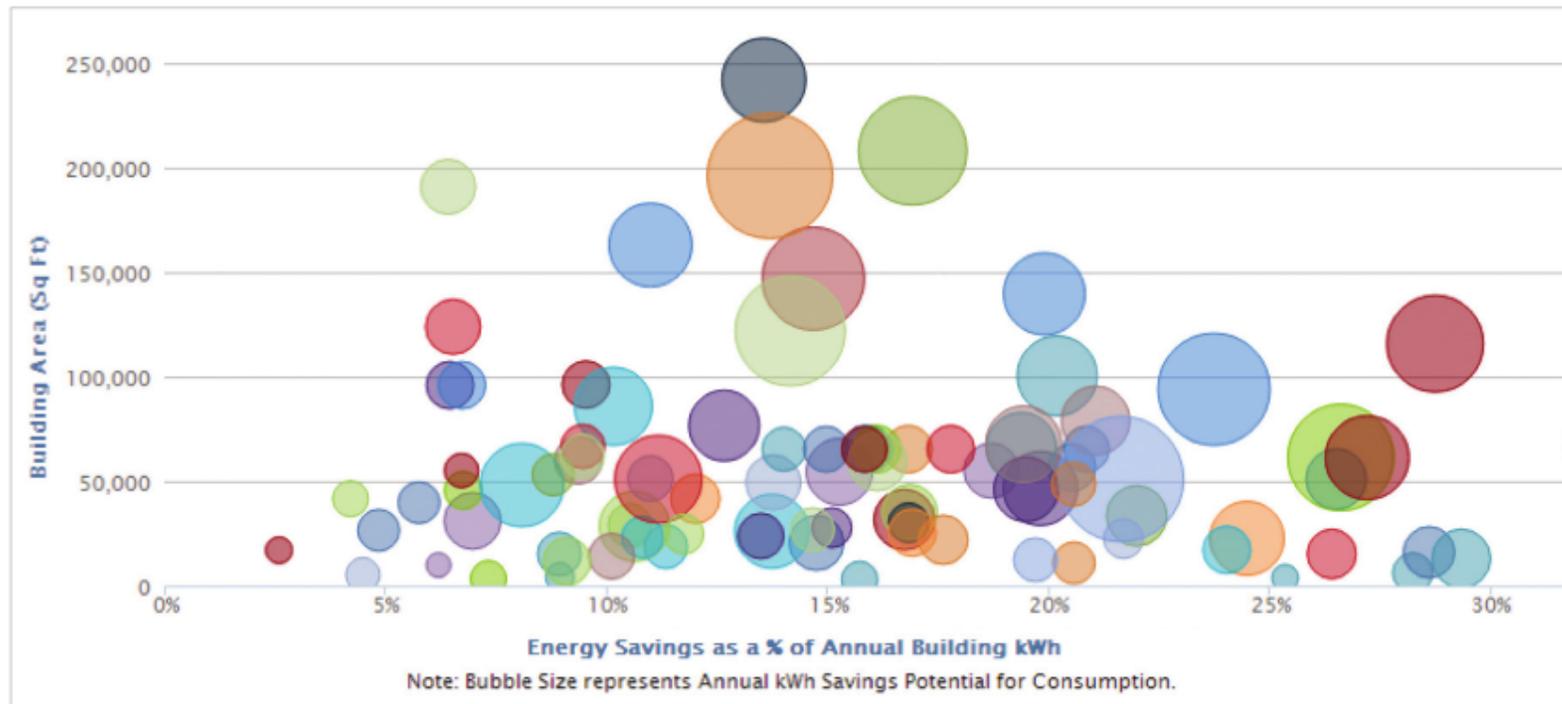
Building owners/operators track ongoing savings from efficiency actions



- Elapsed time of ~2 weeks compared to ~2-4 months with onsite audits
- Building manager time commitment of <2 hours compared to >8 hours for onsite audits

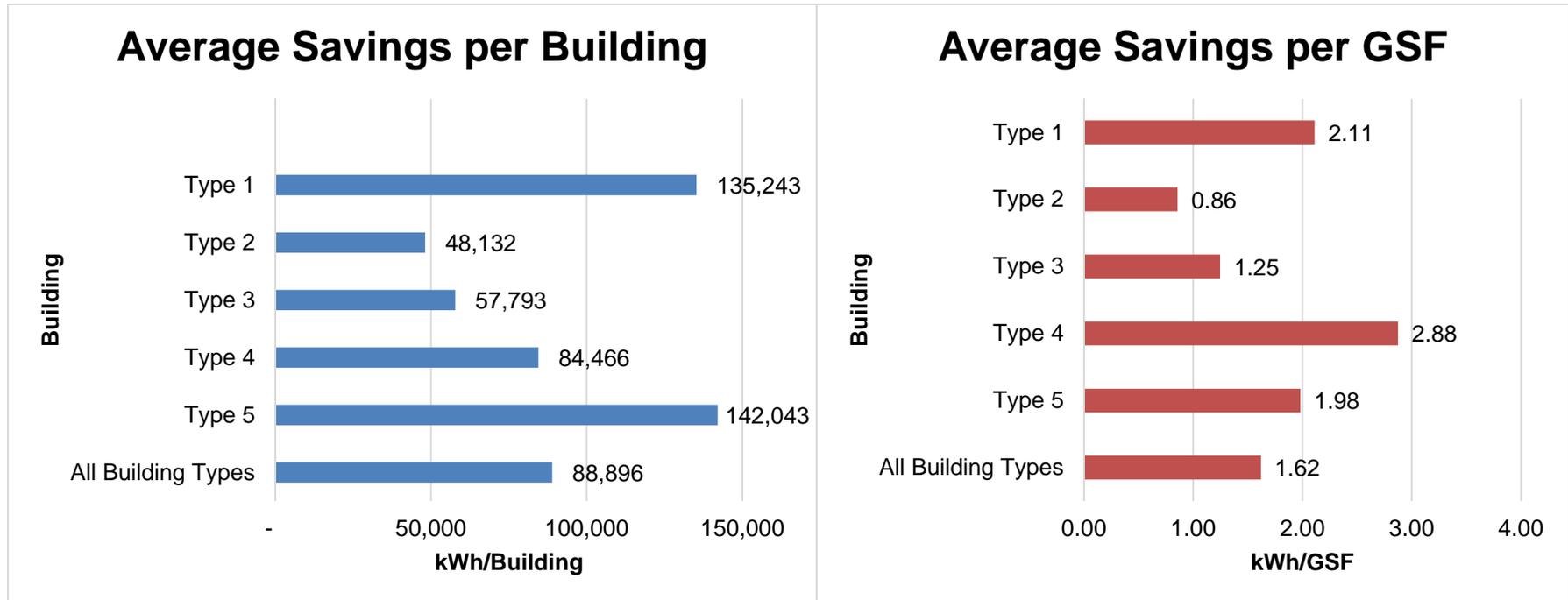
# Portfolio-Level Outputs and Analysis

FIRSTFUEL RESULTS FOR 100 DOD BUILDING ANALYSIS



Total Buildings	Total GSF	Annual Consumption (kWh)	Operational Savings (kWh)	Retrofit Savings (kWh)	Total Savings Identified (kWh)	Total \$ Savings Identified*
100	5,290,128	59,284,437	3,122,506	5,456,713	8,167,692	\$816,769

# Targeting Savings



- Significant savings across the different building types, but some are better savings targets than others
- Remote audits tell us where we should go first—Admin buildings and process load facilities have the highest potential

# Fort Bliss: A Case Study

- Goal:
Net Zero by 2020 for water, energy and waste
- Location:
El Paso, TX
- Size:
1.12 million acres, (10% TX/90% NM)
- Population:
29,000+ Active Duty
- Buildings:
2,000 +  
~ 24MM sq ft  
50% portfolio built in past 6 years



# Fort Bliss: A Case Study

- Primary Activity: Physical Fitness Center
  - **Size:** 22,648 sq ft
  - **Consumption:** 633,770 kWh



Recommendations						
	ENERGY	CARBON	INCENTIVES	SAVINGS	COST	ROI
<b>ELECTRICITY</b>	155,129 kWh (24%)	84 tonnes	N/A	\$10,859	\$24.13K to \$34.08K	2.2 Years to 3.1 Years
<b>TOTAL</b>	529,300 kBTU	84 tonnes	N/A	\$10,859		

TYPE	SUMMARY	INCENTIVES	SAVINGS	COST	ROI
+	HVAC Scheduling Control <small>Created by FirstFuel</small>	N/A	\$7,238	\$1,800 to \$3,200	3 Months to 5 Months
+	Lighting Retrofit <small>Created by FirstFuel</small>	N/A	\$2,560	\$13,314 to \$19,971	5.2 Years to 7.8 Years
+	Plug Load Management <small>Created by FirstFuel</small>	N/A	\$735	\$6,415 to \$7,507	8.7 Years to 10.2 Years
+	Demand Controlled Ventilation <small>Created by FirstFuel</small>	N/A	\$211	\$2,600 to \$3,400	12.3 Years to 16.1 Years

- Total potential electric savings: 24% of annual consumption
- Top Recommendations:
  - HVAC Scheduling Control
  - Lighting Retrofit
  - Plug Load Management



# Fort Bliss: A Case Study

- Primary Activity: Vehicle Maintenance Shop
  - **Size:** 115,742 square feet
  - **Consumption:** 1,044,840 kWh



	ENERGY	CARBON	INCENTIVES	SAVINGS	COST	ROI
<b>ELECTRICITY</b>	300,280 kWh (29%)	163 tonnes	N/A	\$21,020	\$91.5K to \$152.5K	4.4 Years to 7.3 Years
<b>TOTAL</b>	1,024,655 kBtu	163 tonnes	N/A	\$21,020		

TYPE	SUMMARY	INCENTIVES	SAVINGS	COST	ROI
+	HVAC Scheduling Control <small>Created by FirstFuel</small>	N/A	\$10,364	\$2,500 to \$5,000	3 Months to 6 Months
+	Lighting Retrofit <small>Created by FirstFuel</small>	N/A	\$7,651	\$71,500 to \$115,000	9.3 Years to 15 Years
+	HVAC Operating and Maintenance Measures <small>Created by FirstFuel</small>	N/A	\$1,825	\$5,000 to \$7,500	2.7 Years to 4.1 Years
+	Upgrade to EE Motors <small>Created by FirstFuel</small>	N/A	\$616	\$10,000 to \$15,000	16.2 Years to 24.4 Years
+	Eliminate Unnecessary Simultaneous Heating and Cooling <small>Created by FirstFuel</small>	N/A	\$564	\$2,500 to \$10,000	4.4 Years to 17.7 Years

- Total potential electric savings: 29% of annual consumption
- 60/40 split between low-cost and capital measures
- Top Recommendations:
  - HVAC Scheduling Control
  - HVAC Operations & Maintenance Measures
  - Eliminate unnecessary Simultaneous Heating and Cooling

## Fort Bliss: A Case Study

- Summary of Benefits
  - Analysis provided actionable items
  - Operational measures were low cost
  - Brought Ft. Bliss closer to Net Zero goals
- Going forward
  - Securing funding to expand, implement and continue with program
  - Address issues of scale as program grows, such as data collection and integration

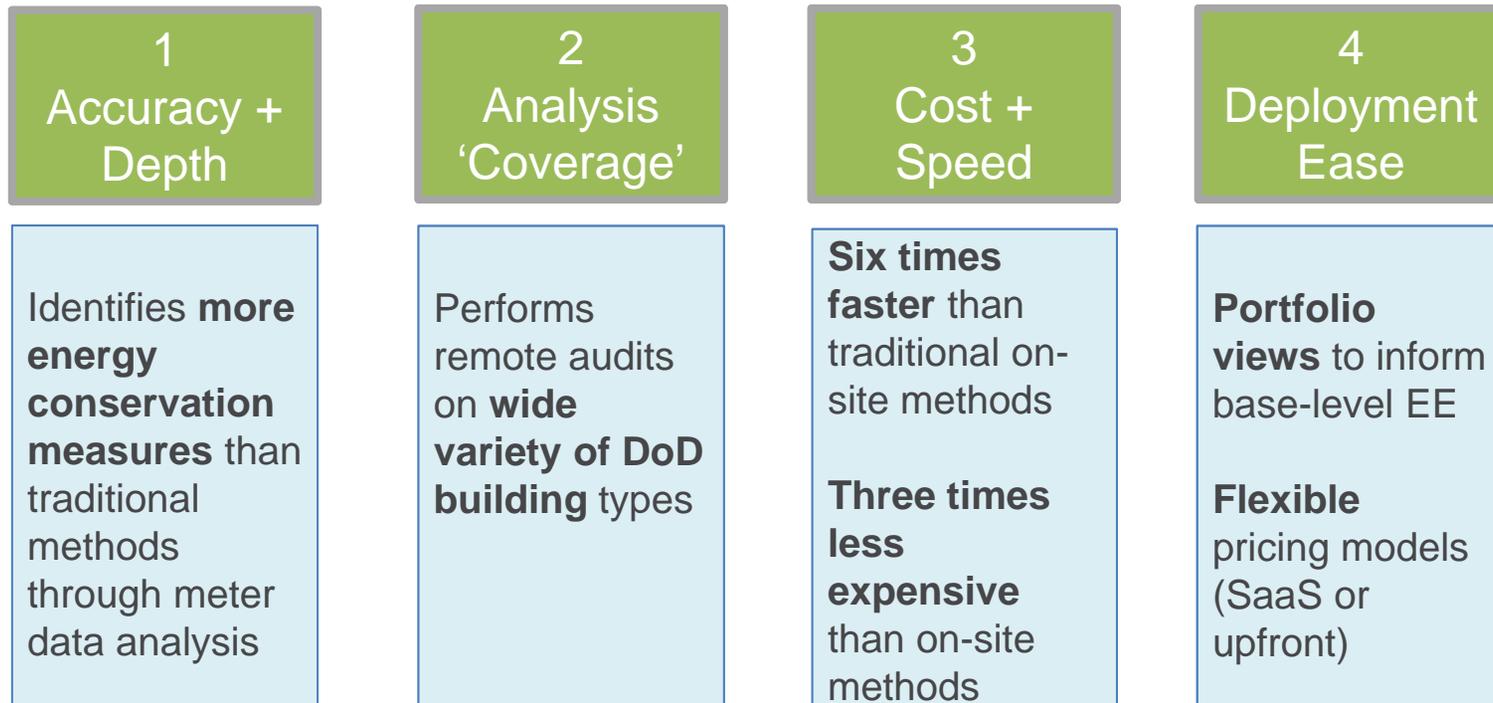


# Program Performance Objectives & Results

Performance Objective	Metric	Success Criteria	Results
<b>Quantitative Performance Objectives</b>			
<b>Cost</b>	FirstFuel Audit price per building and per square foot	<ul style="list-style-type: none"> <li>The average cost for the performed on the 16 ASHRAE Level II audited buildings (Types 1-5) will be less than or equal to \$3,000/building, or \$0.12/ sq ft (whichever is higher)</li> </ul>	<ul style="list-style-type: none"> <li>✓ <b>The average cost for the FirstFuel Audits was equal to \$3,000/building</b></li> </ul>
<b>Scalability</b>	Hours per engineer per FirstFuel Audit	<ul style="list-style-type: none"> <li>FirstFuel Audits for Type 1 buildings completed in 75% of the time of onsite ASHRAE LII Audits.</li> <li>FirstFuel Audits for Type 2-5 completed in 50% of the time of onsite ASHRAE LII Audits.</li> </ul>	<ul style="list-style-type: none"> <li>✓ <b>FirstFuel Audits for Type 1 buildings completed in 16% of the time of onsite ASHRAE LII audits</b></li> <li>✓ <b>FirstFuel Audits for Type 2-5 buildings completed in 15% of the time of onsite ASHRAE LII Audits</b></li> </ul>
<b>Accuracy</b>	<ul style="list-style-type: none"> <li># of FirstFuel audits recommendation s identified</li> <li># of ASHRAE Level II recommendation s</li> </ul>	<ul style="list-style-type: none"> <li>RBA finds 80% of the ECMs found in Building Type 1 ASHRAE LII audits.</li> <li>RBA finds 60% of the ECMs found in Building Types 2-5</li> <li>RBA finds recommendations NOT found in Type 1 Building ASHRAE LII onsite audits.</li> </ul>	<ul style="list-style-type: none"> <li>✓ <b>FirstFuel Audits found 61% of the recommendations found in Building Type 1 ASHRAE LII audits (1)</b></li> <li>✓ <b>FirstFuel Audits found 65% of the recommendations found in Building Type 2-5 ASHRAE LII audits</b></li> <li>✓ <b>FirstFuel Audits found 18 recommendations NOT found in Type 1 building ASHRAE LII onsite audits</b></li> </ul>

# Lessons Learned and Outcomes

- Meter data collection hurdles → Big opportunity to increase value from AMI deployments
- Technology has been validated → shift in focus to measure implementation



# Conclusions

- Analytics-enabled (A-E) energy efficiency:
  - Provides valuable information at both the building and portfolio levels
  - Builds on existing efforts and is easy to deploy
  - Audits buildings quicker and cheaper than traditional methods
  - Delivers solid, actionable results, many at no-to-low cost
  - Helps achieve aggressive savings targets department-wide

# *SERDP & ESTCP Webinar Series*

For additional information, please visit:  
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Full report from ESTCP at [http://www.serdp-estcp.org/Program-Areas/Energy-and-Water/Energy/Conservation-and-Efficiency/EW-201261/EW-201261/\(modified\)/04Aug2014](http://www.serdp-estcp.org/Program-Areas/Energy-and-Water/Energy/Conservation-and-Efficiency/EW-201261/EW-201261/(modified)/04Aug2014)



# *SERDP & ESTCP Webinar Series*

## Q&A Session 2



# *SERDP & ESTCP Webinar Series*

The next webinar is on January 8

DNAPL Source Zone Management

<https://www.serdp-estcp.org/Tools-and-Training/Webinar-Series>



## Survey Reminder

Please take a moment to complete the survey that will pop up on your screen when the webinar ends

