

Thank you for signing in early

The webinar will begin promptly at
12:00 pm ET, 9:00 am PT



SERDP and ESTCP Webinar Series

- The webinar will begin promptly at 12:00 pm ET, 9:00 am PT
- Options for accessing the webinar audio
 - Listen to the broadcast audio if your computer is equipped with speakers
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 - (669) 900-6833 or (929) 205-6099
 - Required webinar ID: 708-683-274
 - YouTube live stream
 - <https://www.youtube.com/user/SERDPESTCP>
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Improving Energy Efficiency through Advanced Building Controls

January 14, 2021



Welcome and Introductions

Rula A. Deeb, Ph.D.
Webinar Coordinator



Webinar Agenda

- **Webinar logistics** (5 minutes)
Dr. Rula Deeb, Geosyntec Consultants
- **Overview of SERDP and ESTCP** (5 minutes)
Mr. Timothy Tetreault, SERDP and ESTCP
- **Improving Building Efficiency through Advanced Controls** (55 minutes + Q&A)
Mr. Dave Vigliotta, Slipstream
Dr. Xiaohui "Joe" Zhou, Slipstream
Mr. Gwelen Paliaga, TRC
- **Final Q&A session**

Zoom Instructions

- Download Zoom
 - <https://zoom.us/download>
- If you cannot download Zoom, you can view the slides using an internet browser
 - Create a free Zoom account (<https://zoom.us/signup>)
 - Use a compatible browser (Firefox, IE or Edge)
 - View the webinar at <https://success.zoom.us/wc/91644633238/join>
- If the material is not showing on your screen or if screen freezes
 - Key in Ctrl + F5 to do a hard refresh of your browser

Zoom Instructions (Cont'd)

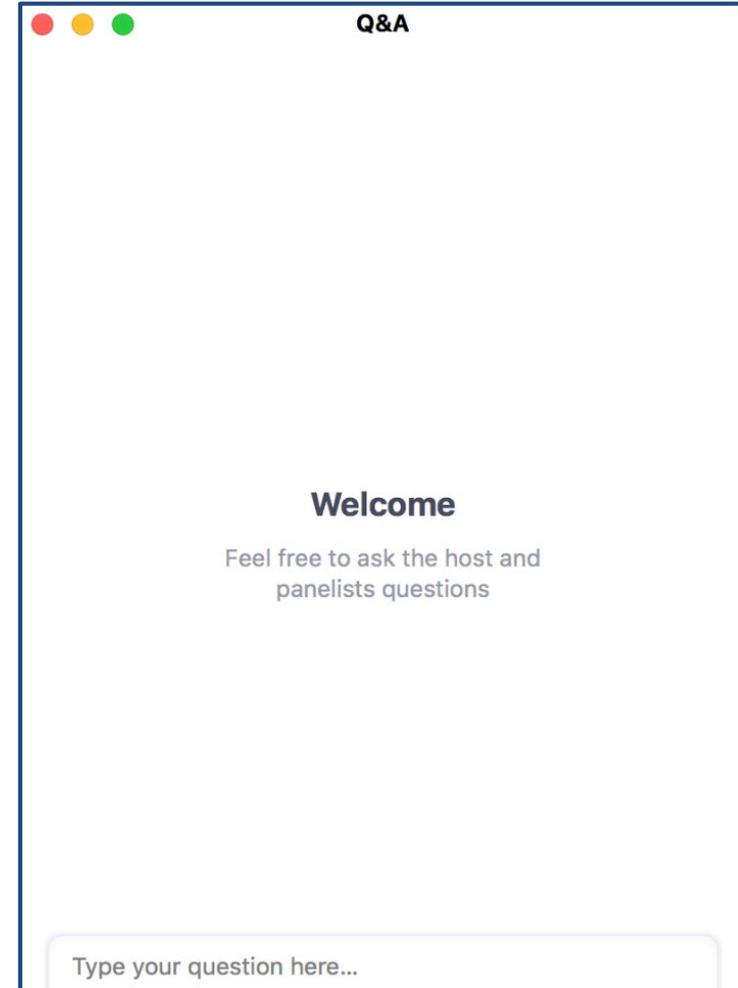
- If you are connecting to computer audio
 - Click the arrow next to the “Join Audio” button
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 - Follow prompts
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- Download a PDF of the slides at <https://serdp-estcp.org/Tools-and-Training/Webinar-Series/01-14-2021> and call into the conference line
 - (669) 900-6833 or (929) 205-6099
 - Required webinar ID: 916-4463-3238
- We will also be live streaming the webinar on the SERDP and ESTCP YouTube channel
 - <https://www.youtube.com/user/SERDPESTCP>

How to Ask Questions

- Find the Q&A button on your control bar and type in your question(s)
- Make sure to add your organization name at the end of your question so that we can identify you during the Q&A sessions



SERDP and ESTCP Overview

Timothy Tetreault
SERDP and ESTCP



SERDP

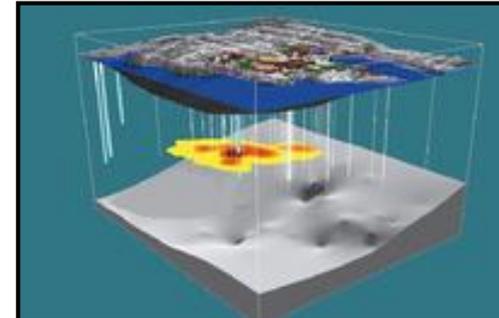
- Strategic Environmental Research and Development Program
- Established by Congress in FY 1991
 - DoD, DOE and EPA partnership
- SERDP is a requirements driven program which identifies high-priority environmental science and technology investment opportunities that address DoD requirements
 - Advanced 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

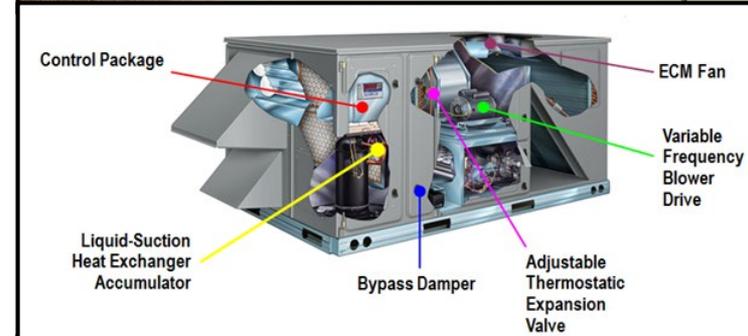
Program Areas

- Environmental Restoration
- Installation Energy and Water
- Munitions Response
- Resource Conservation and Resiliency
- Weapons Systems and Platforms



Installation 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	Topic
January 28, 2021	Improved Approaches for PFAS Sampling and Treatment
February 11, 2021	Advances in the Detection of Submerged Unexploded Ordnance in Marine Environments
February 25, 2021	Managing Chlorinated Solvents in Groundwater Using Biological Treatment
March 11, 2021	New Resource Conservation Paradigms on DoD Lands
March 25, 2021	Safer Alternatives for Surface Engineering and Structural Materials in Weapons Systems and Platforms: A Fred Lafferman Tribute Webinar
April 8, 2021	Advances in Understanding PFAS Ecological Risks
April 22, 2021	Innovative Approaches to Monitor and Survey At-Risk Species on DoD Lands

For upcoming webinars, please visit

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



Improving Building Efficiency through Advanced Controls

David Vigliotta, Slipstream

Xiaohui “Joe” Zhou, Slipstream

Gwelen Paliaga, TRC



Project Objectives and Approach

David Vigliotta
Slipstream



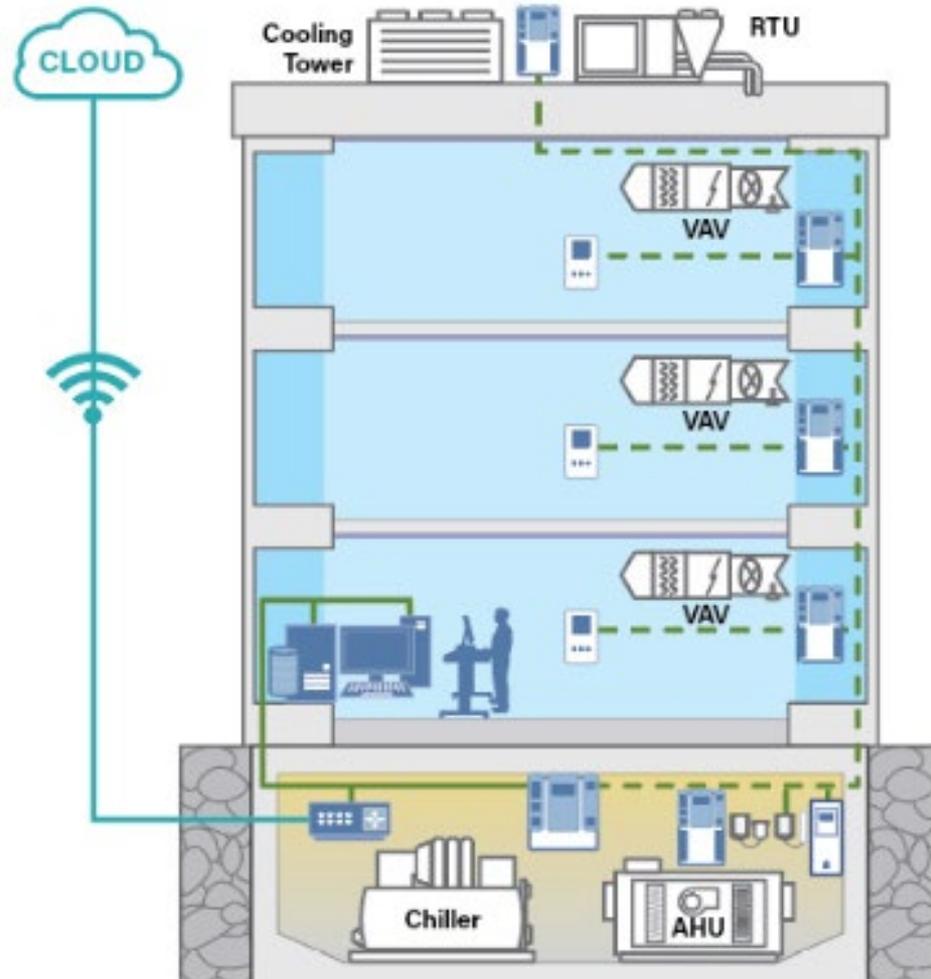
Presentation Outline

- Introduction
- Project approach
- Training modules and topics
- Online training resource demo
- Q&A session 1
- ASHRAE Guideline 36
 - Overview, benefits and field demonstration
- Q&A session 2

Note: ASHRAE = American Society of Heating, Refrigerating and Air-Conditioning Engineers

Introduction

- **Problem statement**
 - Advanced controls could result in an average of ~30% savings
 - Huge knowledge gap within DoD
 - ESTCP projects show promising results
- **Technology transfer**
 - Develop and deliver a comprehensive education and training curriculum
 - Disseminate concepts and applications to multiple target audiences



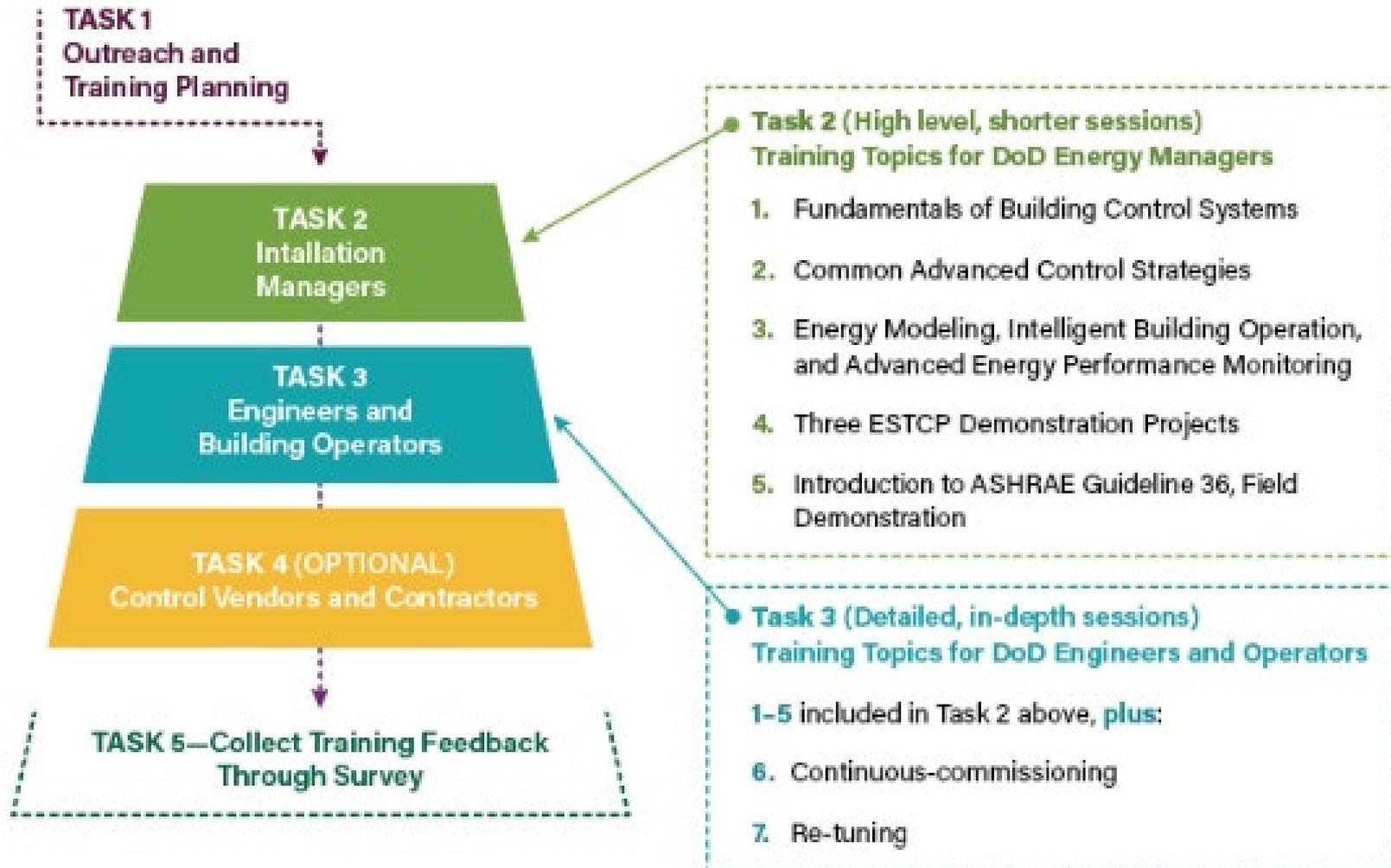
Objectives

- Improve understanding and awareness
- Increase knowledge gap of key building controls concepts
- Educate managers and engineers on ASHRAE Guideline 36
- Teach re-tuning and continuous commissioning using BAS
- Influence the Unified Facilities Guide Specifications



Note: BAS = building automation systems

Project Approach



Training Modules and Topics

Xiaohui “Joe” Zhou, P.E.
Slipstream



Online Training Resource Demo

- For DoD energy managers
- Four modules
 - Fundamentals of building control systems
 - Advanced control strategies
 - Energy modeling, intelligent building operations, and advanced energy performance
 - Three control related ESTCP projects
- Total of 16 short sessions (10~20 minutes)

Online Training Resource Demo

- For DoD energy engineers and facility operators
- Four modules, a total of 22 hour-long sessions
 - Fundamentals of building control systems
 - Advanced control strategies
 - Energy modeling, intelligent building operations, and advanced energy performance
 - Four control related ESTCP projects
 - Existing building commissioning
- Expect to be ready before June 2021

Online Training Resource Demo



Building Controls for Energy Managers

DUE DATE
 N/A

EXPIRY DATE
 N/A

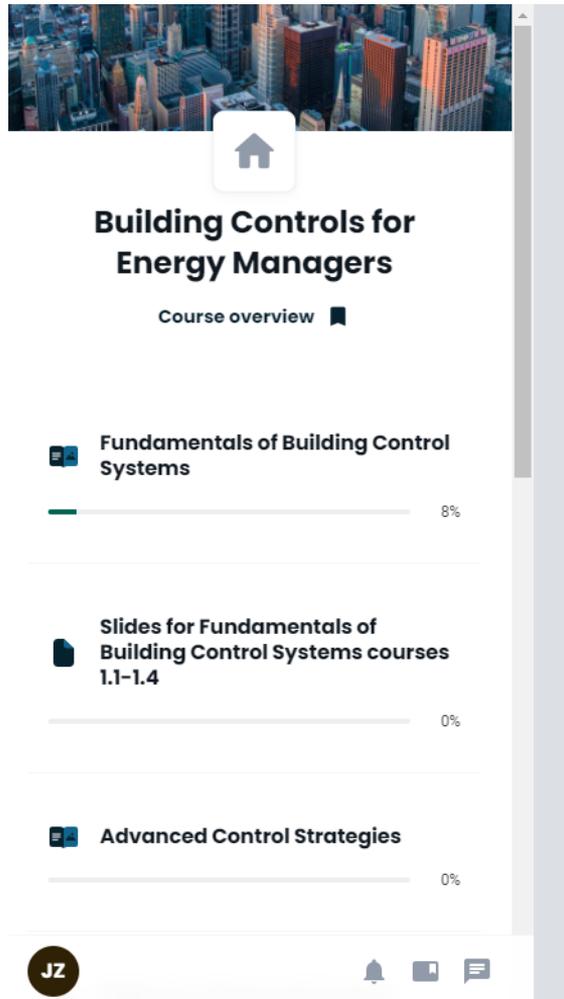
[Start course →](#)



Overview

Did you know that advanced building controls and energy management strategies could result in an average of nearly 30% energy savings? Unfortunately, there is an industry-wide knowledge gap that addresses how to utilize advanced controls to capitalize on energy savings and ensure buildings run at peak performance.

Online Training Resource Demo



The screenshot shows a course page with a city skyline header image. A home icon is centered over the image. Below the image, the course title 'Building Controls for Energy Managers' is displayed, followed by a 'Course overview' link. A progress bar shows 8% completion for 'Fundamentals of Building Control Systems'. Below that, 'Slides for Fundamentals of Building Control Systems courses 1.1-1.4' is listed with a 0% completion bar. At the bottom, 'Advanced Control Strategies' is listed with a 0% completion bar. A user profile icon 'JZ' and notification icons are visible at the bottom of the interface.

Speakers



Xiaohui "Joe" Zhou, Principal Engineer, Slipstream

Xiaohui "Joe" Zhou is a principal engineer at Slipstream headquartered in Madison, WI. Joe's has 25+ years of experience in building controls and his current areas of research focus on the emerging technology and product field testing and verification. Before joining Slipstream, he worked for several organizations including 15 years with the Iowa Energy Center and 2 years with Johnson Controls. He served as principal investigator for multi-million-dollar R&D projects sponsored by U.S. DOE, DOD, DOC, ASHRAE, and utilities. Joe is a member of ASHRAE and

Online Training Resource Demo



Building Controls for Energy Managers

Course overview

Fundamentals of Building Control Systems

8%

1.1. Introduction to Building Auto... 2/6

1.1.a. Introduction to Building Autom... ✓

1.1.b. Quiz 0/3

Q1 Which one of the following acrony...

Q2 There are two types of field contr...

Q3 According to Unified Facility Crite...

1.1.c. Survey

JZ



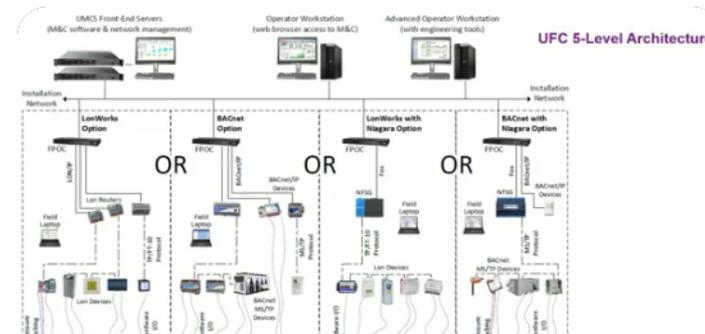
Fundamentals of Building Control Systems

1 of 12



1.1a. Introduction to Building Automation System Architecture Video

Intro. video



Introduction to Building Automation System

Online Training Resource Demo

 **Fundamentals of Building Control Systems**

8%

1.1. Introduction to Building Auto... 2/6

1.1a. Introduction to Building Autom... ✓

1.1b. Quiz 0/3

Q1 Which one of the following acrony...

Q2 There are two types of field contr...

Q3 According to Unified Facility Crite...

1.1c. Survey ✓

1.2. BACnet, LonWorks, and Niag... 0/3

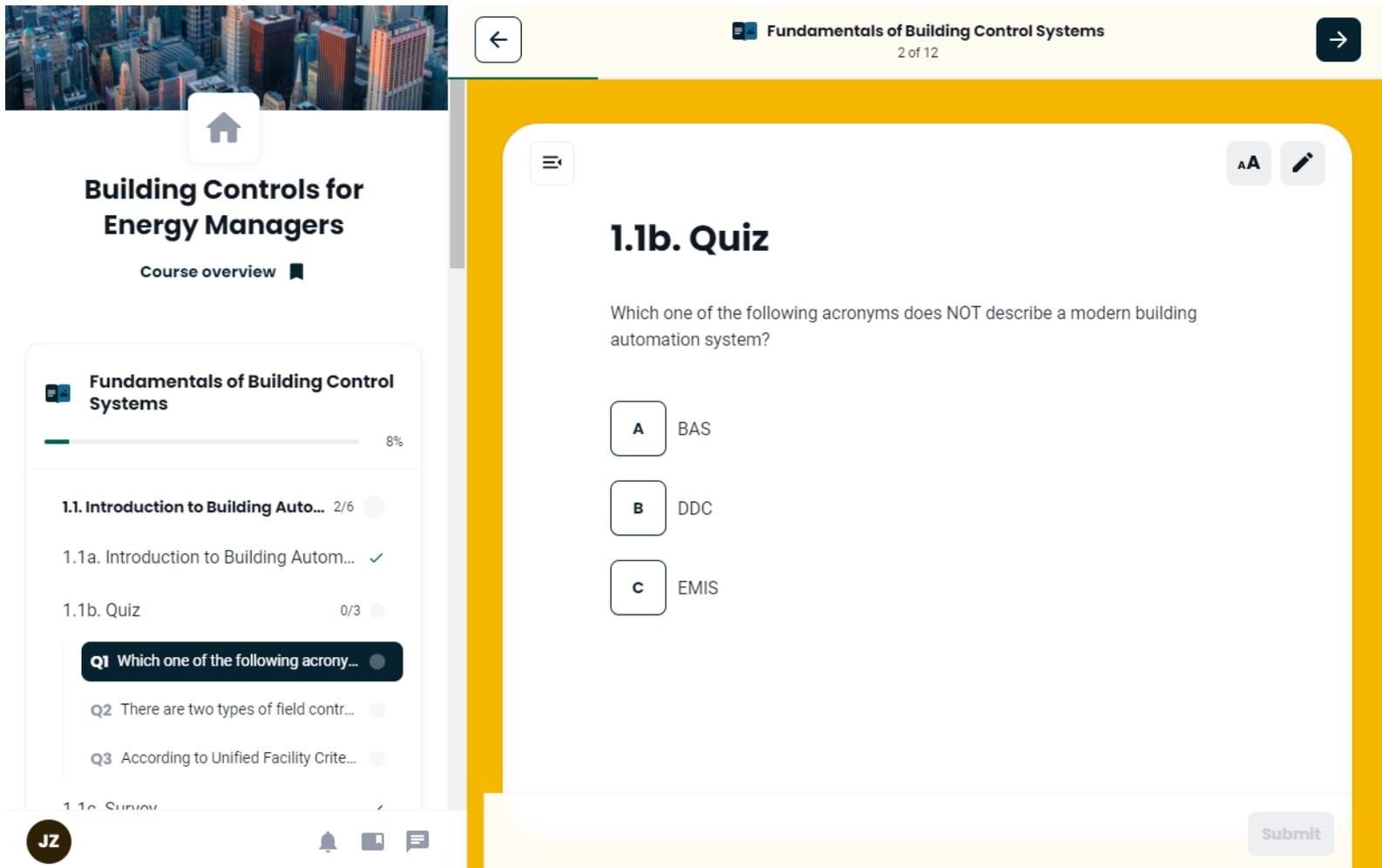
1.2a. BACnet, LonWorks, and Niagar...

1.2b. Quiz

1.2c. Survey

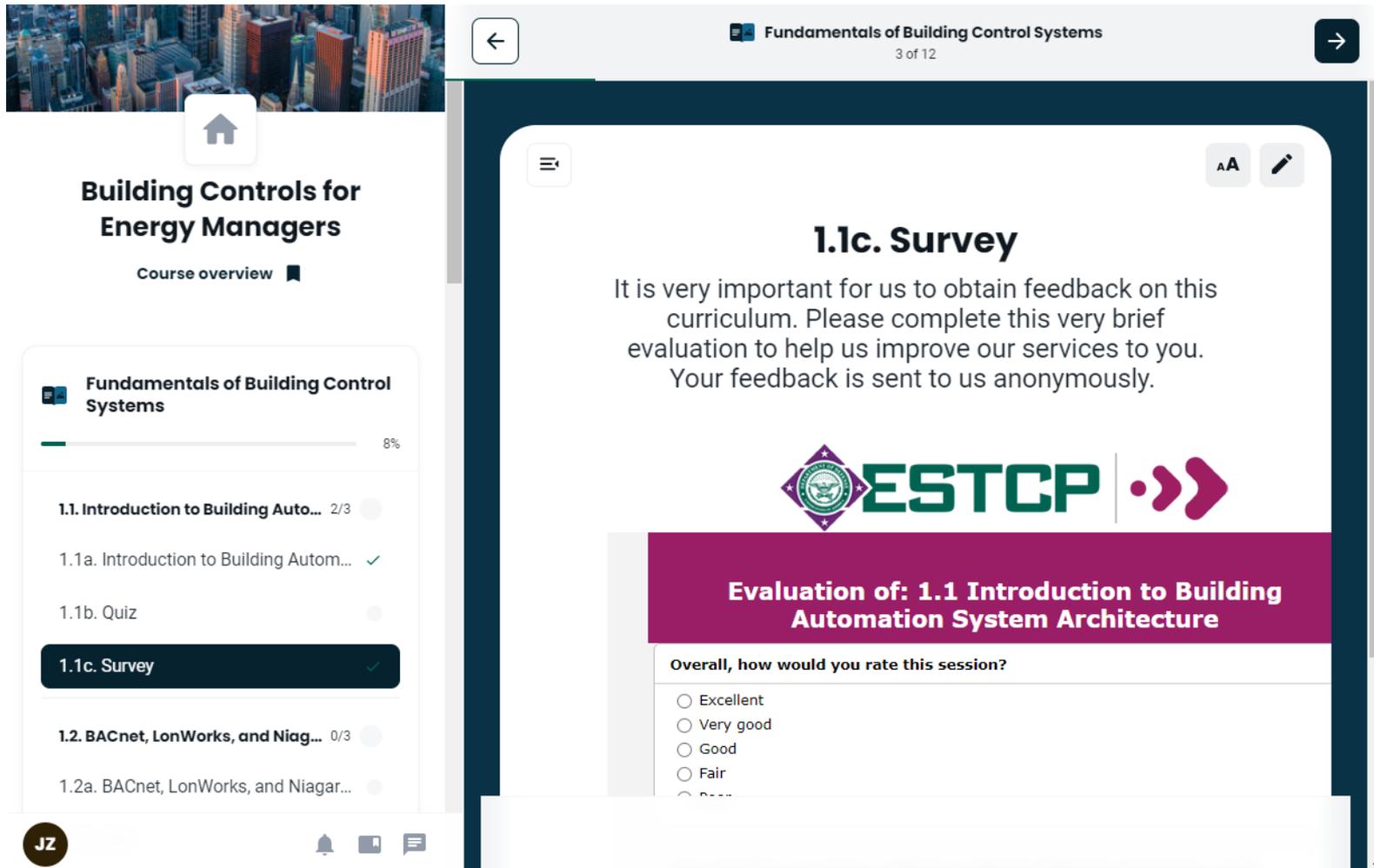
1.3. Basics of HVAC Controls - Co... 0/3

Online Training Resource Demo



The screenshot displays a web-based training interface. At the top, a navigation bar shows the course title "Fundamentals of Building Control Systems" and the current page number "2 of 12". Below this, a sidebar on the left provides a course overview for "Building Controls for Energy Managers", indicating that 8% of the course has been completed. The overview lists several sections, with "1.1b. Quiz" currently selected. The main content area displays a quiz question: "1.1b. Quiz" followed by the text "Which one of the following acronyms does NOT describe a modern building automation system?". Three multiple-choice options are provided: A) BAS, B) DDC, and C) EMIS. A "Submit" button is located at the bottom right of the quiz area. The interface also includes a home icon, a course overview icon, and a user profile icon labeled "JZ".

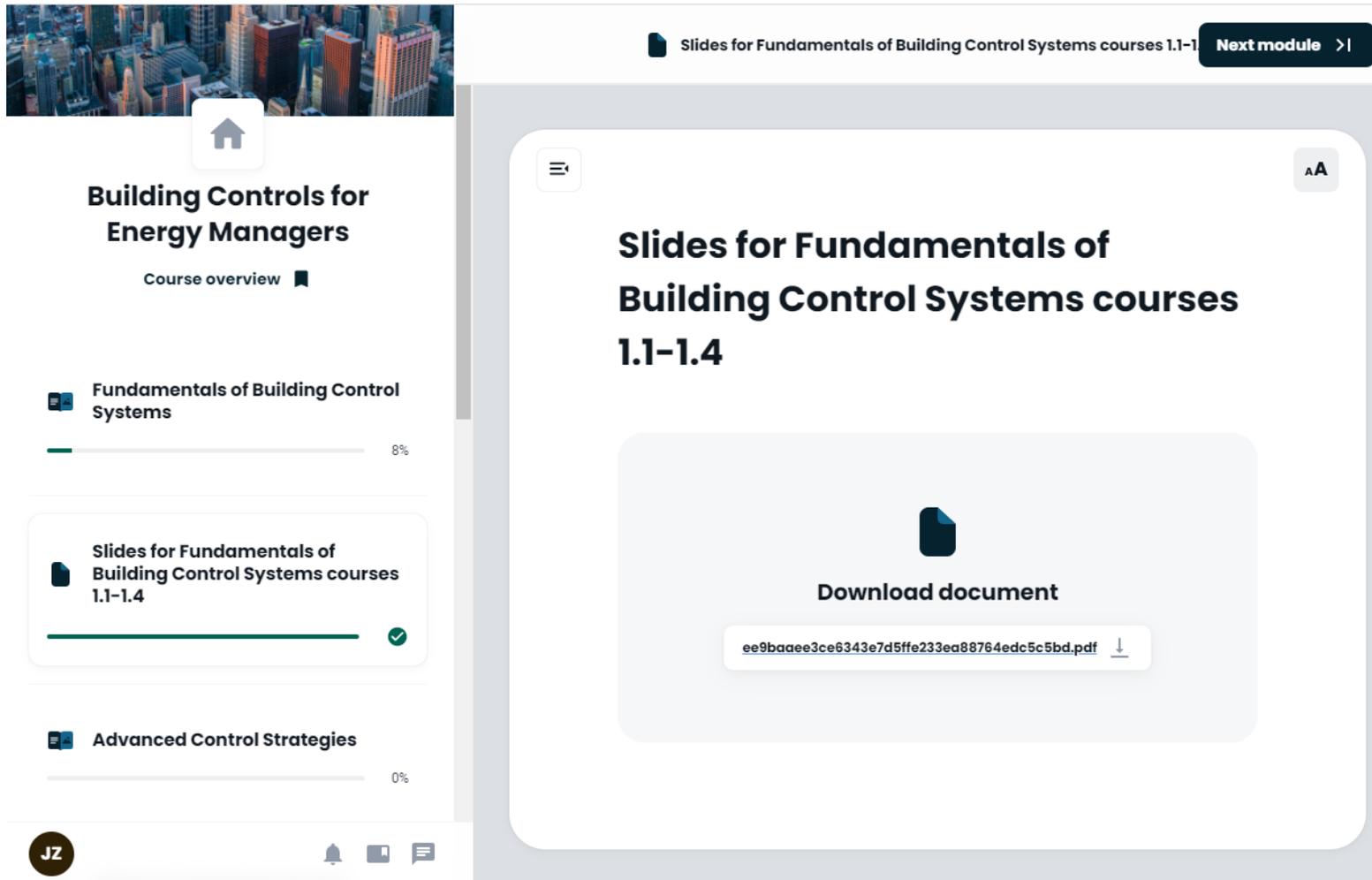
Online Training Resource Demo



The screenshot shows a web-based training interface. On the left is a navigation sidebar with a home icon at the top, followed by the course title 'Building Controls for Energy Managers' and a 'Course overview' link. Below this is a progress bar for 'Fundamentals of Building Control Systems' at 8%. The course content is organized into sections: '1.1. Introduction to Building Auto...' (2/3 items), '1.2. BACnet, LonWorks, and Niagar...' (0/3 items), and '1.2a. BACnet, LonWorks, and Niagar...'. Under section 1.1, the items are '1.1a. Introduction to Building Autom...' (checked), '1.1b. Quiz', and '1.1c. Survey' (checked and highlighted). At the bottom of the sidebar is a user profile icon for 'JZ' and notification icons.

The main content area displays the '1.1c. Survey' page. It features a back arrow, the course title 'Fundamentals of Building Control Systems', and '3 of 12' indicating the current slide. The survey text reads: 'It is very important for us to obtain feedback on this curriculum. Please complete this very brief evaluation to help us improve our services to you. Your feedback is sent to us anonymously.' Below the text is the ESTCP logo and a purple banner that says 'Evaluation of: 1.1 Introduction to Building Automation System Architecture'. The survey question is 'Overall, how would you rate this session?' with radio button options: 'Excellent', 'Very good', 'Good', 'Fair', and 'Poor'.

Online Training Resource Demo



Slides for Fundamentals of Building Control Systems courses 1.1-1.4 **Next module >**

Building Controls for Energy Managers

Course overview

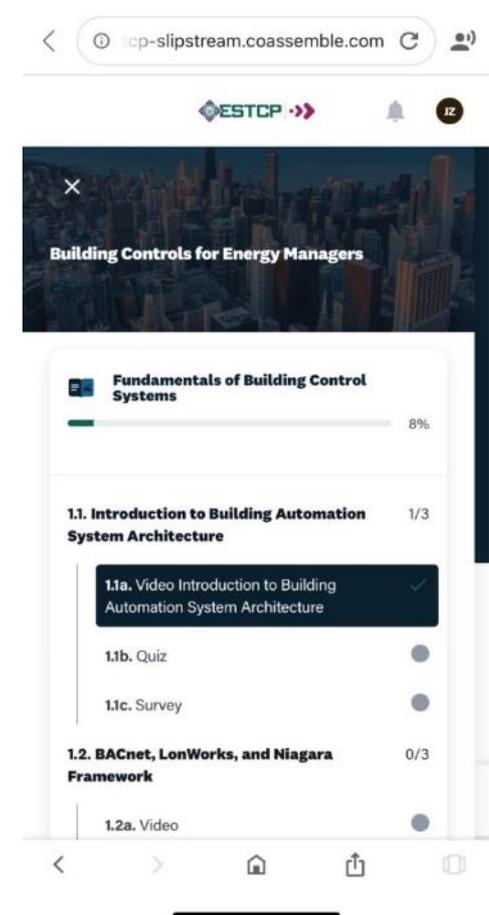
- Fundamentals of Building Control Systems 8%
- Slides for Fundamentals of Building Control Systems courses 1.1-1.4 100%
- Advanced Control Strategies 0%

Slides for Fundamentals of Building Control Systems courses 1.1-1.4

Download document

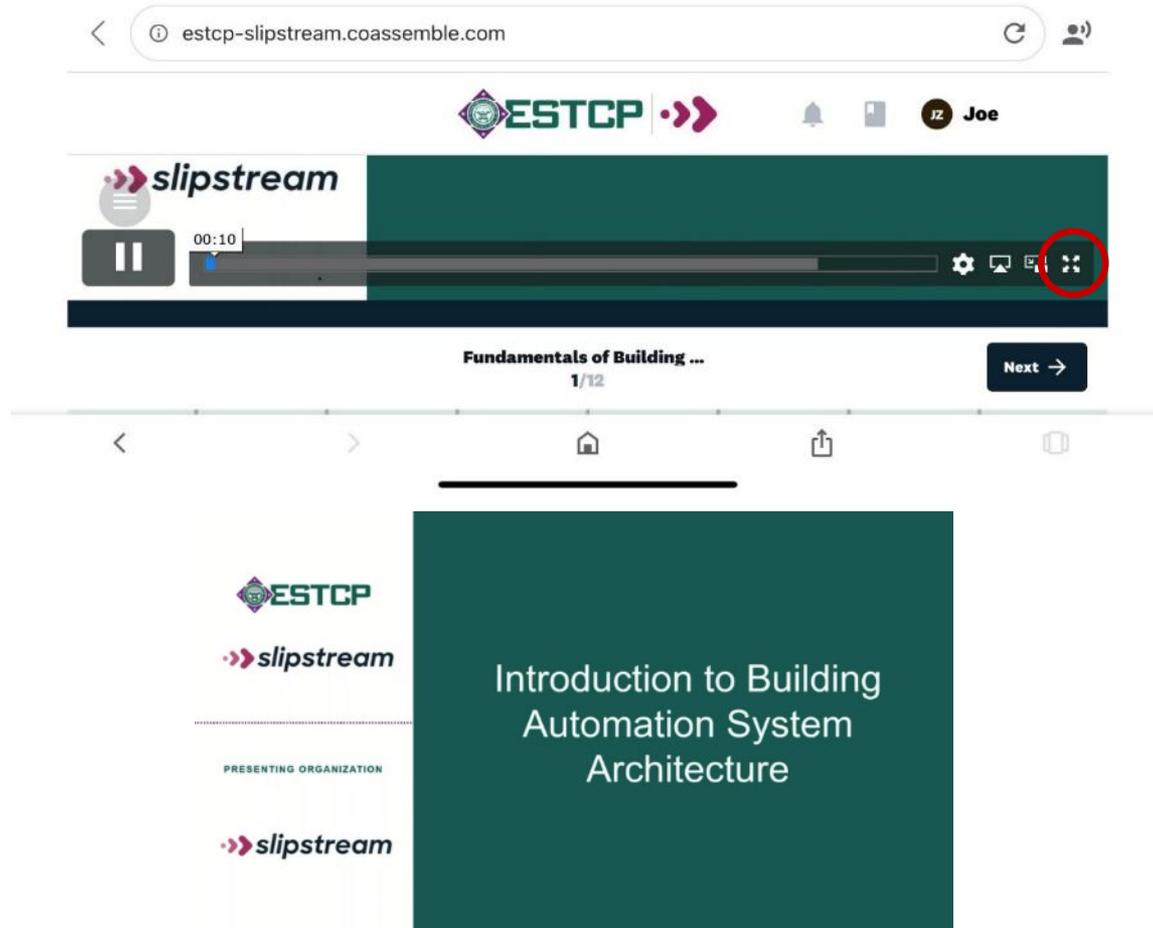
[ee9baaee3ce6343e7d5ffe233ea88764edc5c5bd.pdf](#)

Online Training Resource Demo



Portable Device Views - Vertical

Online Training Resource Demo



Portable Device Views - Horizontal

Online Training Resource Demo

- Hosted at **Slipstream Learning Management System** (LMS) platform
- Education materials available at no cost to DoD audiences and stakeholders
 - One-time registration at <https://estcpcoassemble.paperform.co/>
 - Slipstream LMS platform web address <https://estcp-slipstream.coassemble.com/>

Q&A Session 1



ASHRAE Guideline 36

Gwelen Paliaga, P.E.
TRC

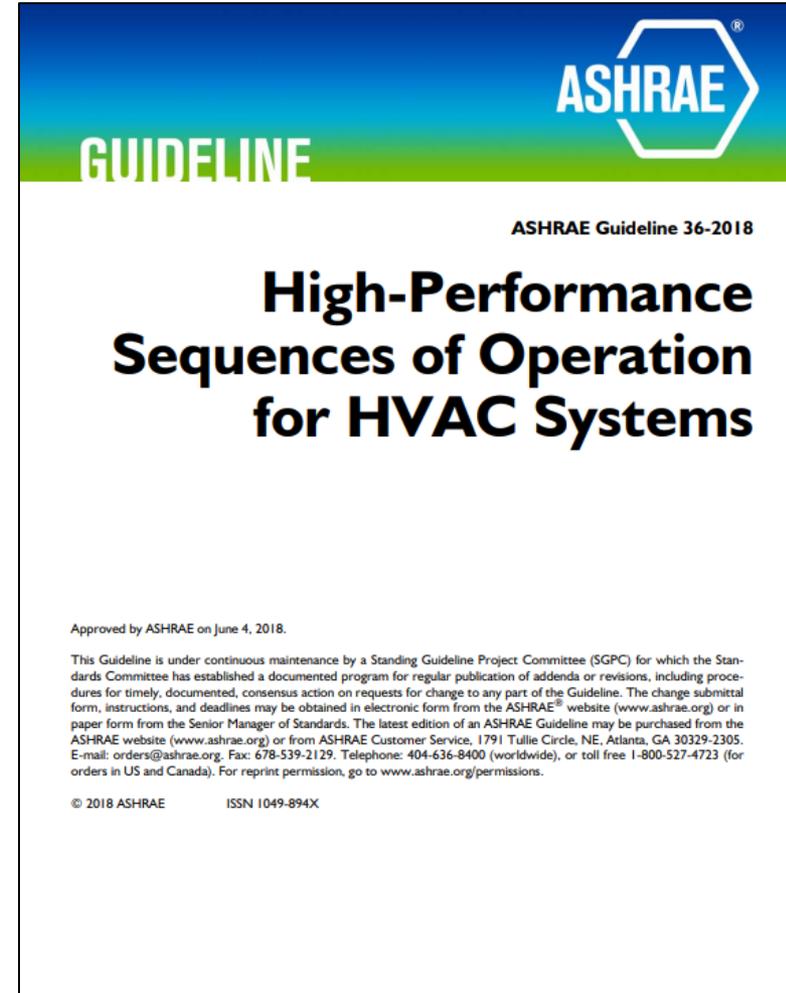


ASHRAE Guideline 36

- Introduction to ASHRAE Guideline 36
- Benefits of ASHRAE Guideline 36
- Demonstration projects
- Preliminary results
- HVAC and lighting integration
- Market development

ASHRAE Guideline 36

- Based on industry best practices
 - ASHRAE standing committee with broad representation
 - Consensus process
 - Multiple rounds of public review
- First published in 2018
 - Now under continuous improvement



ASHRAE Guideline 36

ASHRAE GUIDELINE 36

Uniform, best-in-class sequence of operations for HVAC systems to maximize efficiency, performance, and control

FORM

Written sequences, points lists, control diagrams & embedded instructions

CURRENT SCOPE

Generic thermal zones, VAV terminals, fan powered terminals, single- & multi-zone systems, and dual duct systems

FEATURES

- General logic: VFD minimums, trim & respond, rogue zones, equipment staging, alarms
- VAV terminal dual-maximum logic
- Demand-based temperature & pressure resets
- Demand-controlled ventilation (Title 24 & ASHRAE 62.1)
- Real-time fault detection & diagnostics
- Demand limiting
- Hierarchical alarm suppression
- Economizer: sequencing, high limit lockout, building pressure control

ASHRAE Guideline 36

Title, Purpose, Scope

- Title
 - High-Performance Sequences of Operation for HVAC Systems
- Purpose
 - Provide uniform sequences of operation for HVAC systems
 - Maximize HVAC system energy efficiency and performance
 - Provide control stability
 - Allow for real-time fault detection and diagnostics
- Scope
 - Detailed sequences of operation for HVAC systems
 - Functional tests to confirm implementation of the sequences of operation

Benefits Across HVAC Industry

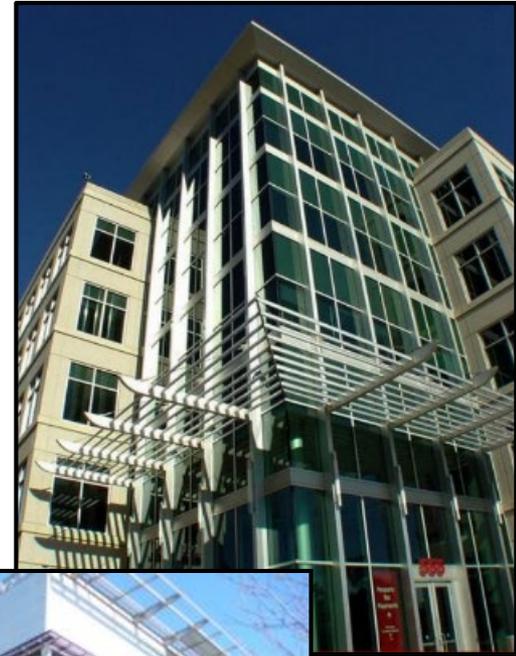
Standardization + High Performance Sequences =

	Facilities Management	Owner/ Customer	Design Engineer	Controls Contractor	Controls Manufacturer	Commissioning Agent
Energy		Reduced energy use & costs				
Implementation Effort	Reduced staff training & maintenance cost	Lower design & construction costs	Less effort to design	Less effort to implement		Less effort to test
Occupant	Fewer occupant complaints	Improved thermal comfort				
Building operations	Improved operations	Higher quality				
Market share				Increased market demand		
Customer satisfaction			Increased customer satisfaction			

Energy Savings and Payback Potential

Previous Research Promising Results

- 555 County Center
 - Full controls modernization
 - Whole building savings
 - 15% electricity
 - 56% natural gas
 - 6.7 year payback
- Partial G36 sequences
 - 7 buildings for ASHRAE RP-1515
 - HVAC savings of 10-30%
 - < 1 year payback
- Simulation studies
 - ~30% whole building savings



Note: G36 = ASHRAE Guideline 36

SERDP & ESTCP Webinar Series (#125)

Save Energy While Eliminating Overcooling

- ASHRAE research results (RP-1515)
 - Improved zone controller sequences
 - Use dual-maximum sequences
 - Allow minimum airflow to drop to ventilation rate
- Energy savings
 - < 1 year payback
- Eliminated overcooling
 - Decreased cold discomfort by 50% (in summer)
 - Increased average zone temperatures $\sim 2^{\circ}\text{F}$



G36 Demonstration and Market Development



Hardware Upgrade



BAS Optimization
HVAC Controls
Sequencing
ASHRAE Guideline
36



Measurement & Verification



Lessons Learned



Market Development Tools
Resources
BAS Industry Transformation

Demonstration Sites

California (CEC): 7 Sites in Progress

Hardware + Software



KP Whittier Medical
Office Building
Whittier



KP Fresno Medical
Office Building, Fresno



CSUDH LaCorte Hall
University Building
Dominguez Hills



KP Vallejo
Medical Office Building
Vallejo



KP Pleasanton
Data Center and Office
Pleasanton



Contra Costa College
Admin Office Building
Richmond



KP Oakland
Medical Office Building
Oakland

Software Only

Note: CEC = California Energy Commission

Demonstration Sites

New York (NYSERDA): 4 Sites Being Selected

Hardware + Software



TBD Sm. Comm.
Bldg 1
New York State



TBD Sm. Comm.
Bldg 2
New York State



TBD Sm. Comm.
Bldg 3
New York State



TBD Sm. Comm.
Bldg 4
New York State

Software Only

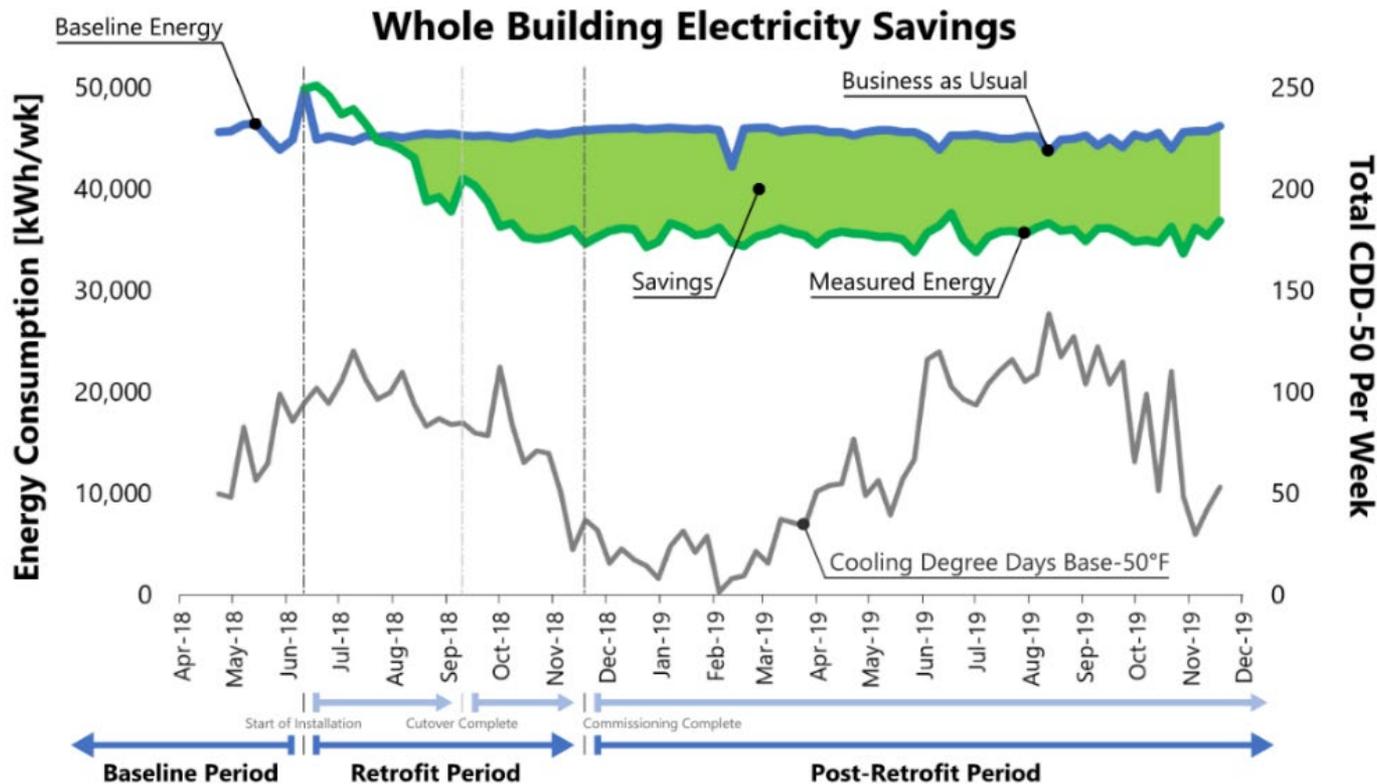
Note: NYSERDA = New York State Energy Research and Development Authority

Field Demonstration Progress

Site	Site		Design		Bid		Construction			Commissioning		Reporting	
	Site Selection	Gather Site Data	Develop Sequences	Develop Bid Documents	Issue Bid Documents	Controls Contractor Selection	Submittal Reviews	Hardware Installation	Implement Programming	Functional Tests	Trend Review	Post-retrofit Analysis	Reporting
KP Vallejo MOB	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
CCC SAB	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	80%	20%
KP Pleasanton Data Center	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	60%	10%
KP Whittier MOB Phase 1	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	20%	0%	0%
KP Whittier MOB Phase 2	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	20%	0%	0%
CSUDH LaCorte Hall	100%	100%	100%	100%	100%	100%	100%	100%	20%	0%	0%	0%	0%
KP Oakland SMOB	100%	100%	100%	100%	100%	100%	50%	20%	10%	0%	0%	0%	0%
KP Fresno MOB	100%	100%	100%	100%	100%	90%	0%	0%	0%	0%	0%	0%	0%

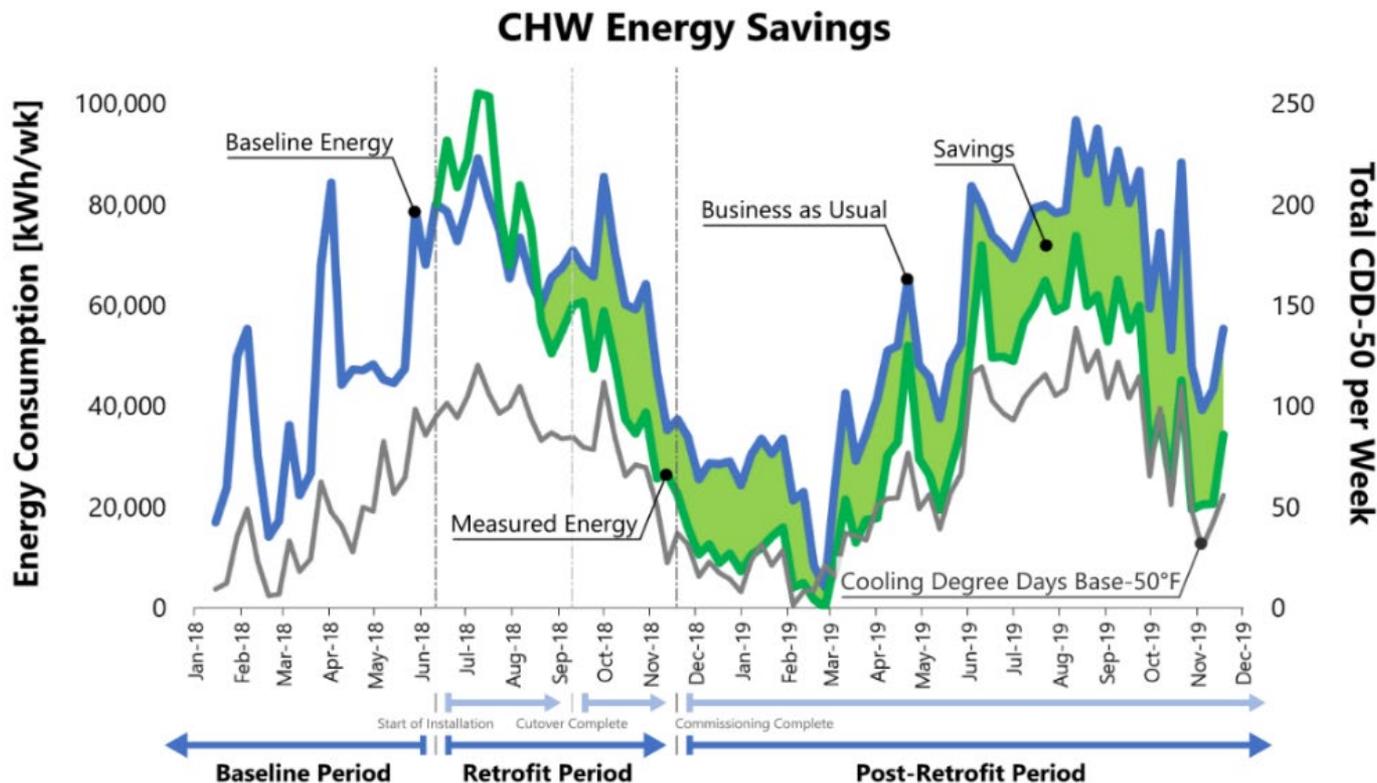
Energy Savings Results

- Medical Office Building in Vallejo, CA



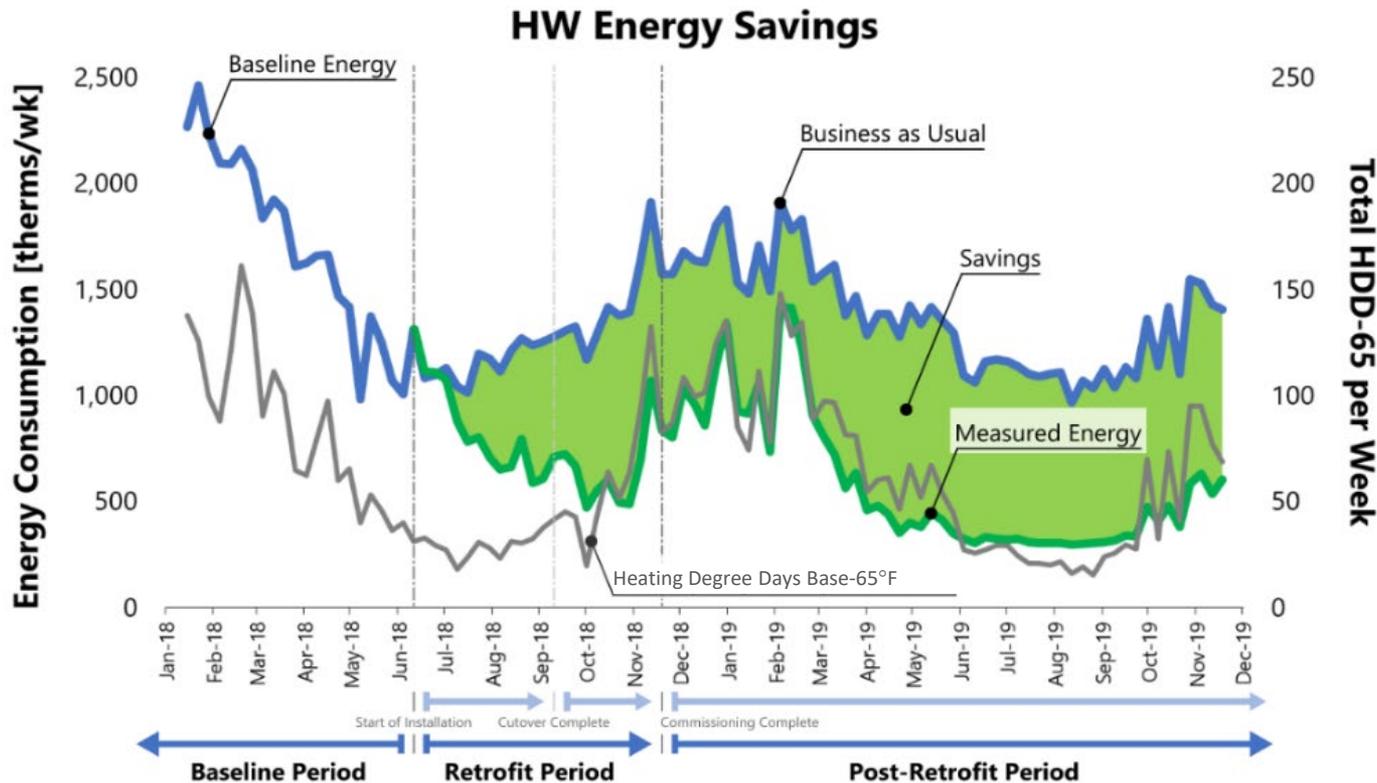
Energy Savings Results

- Medical Office Building in Vallejo, CA



Energy Savings Results

- Medical Office Building in Vallejo, CA



Preliminary Results: Energy and Payback

	HVAC Savings (%)	Whole Building Savings (%)	Estimated First Costs* (\$)	Simple Payback (yrs)	Project Scope
KP Vallejo Medical Office Building	78% electricity 40% CHW 61% HW	22% electricity	\$1.7M * (\$8.86/sqft)	8 yrs	Complete hardware retrofit to replace existing pneumatic VAV controllers
Contra Costa Community College Admin Building	38% Fan 35% CHW 4% HW	-	\$41k (\$0.77/sqft)	10 yrs	Re-programming only
KP Pleasanton Data Center Offices	52% Fan -0.5% CHW 12% gas	-	\$24k ** (\$1.00/sqft)	3 yrs	Re-programming only

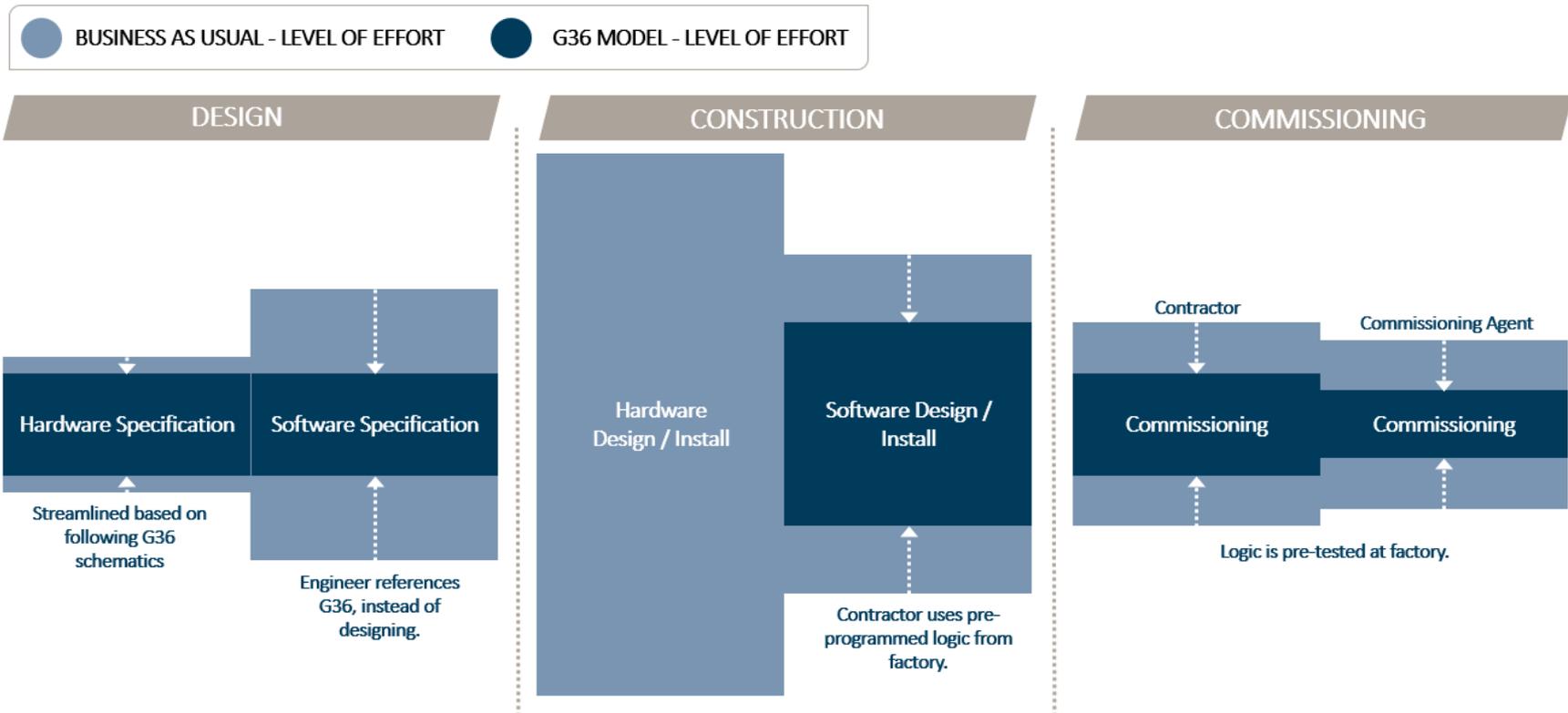
- Final results will be included in final reports
 - CEC EPC-17-001 Best-in-Class & NYSERDA PON 3519 Plug-and-Play

Notes: * = construction scope was beyond G36; proportion specifically for G36 scope was estimated;

** = estimate based on other projects

Market Development

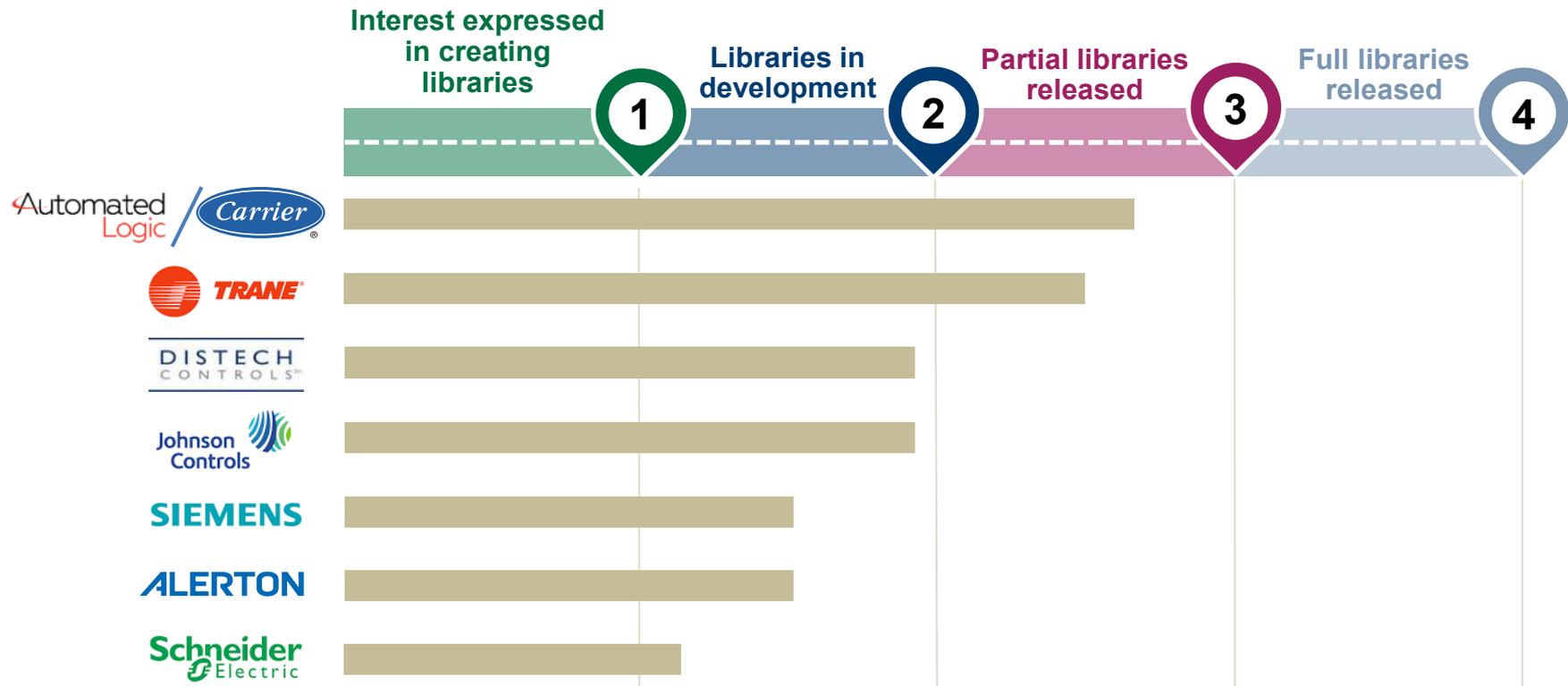
- Goal: Standardize, pre-programmed, and vetted programming



G36 Libraries

Factory Application Libraries

Status August 2020



Conclusions

- Standardization leads to benefits across the HVAC industry
- Whole building energy savings
 - Up to 30%
 - ~ 3-10 year payback
- BAS manufacturers are creating factory application libraries
- Anticipate decreased costs and streamlined process with standardization

Benefits to DoD

- G36 retrofit widely applicable across DoD buildings
- Good energy payback to support BAS modernization
- Standardization improves facility operations across sites and portfolios

Acknowledgments



Srinivas Katipamula (PNNL) | David Claridge (TAMU) | Michael Chipley (PMC) | Capt. Miles Ryan (AFIT)

SERDP & ESTCP Webinar Series

For additional information, please visit

[https://www.serdp-estcp.org/Program-Areas/Installation-Energy-and-](https://www.serdp-estcp.org/Program-Areas/Installation-Energy-and-Water/Energy/Conservation-and-Efficiency/EW19-5055)

[Water/Energy/Conservation-and-Efficiency/EW19-5055](https://www.serdp-estcp.org/Program-Areas/Installation-Energy-and-Water/Energy/Conservation-and-Efficiency/EW19-5055)

Speaker Contact Information

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jzhou@slipstreaminc.org; 608-210-7155

gpaliaga@trccompanies.com; 510-224-4496



Q&A Session 2



The next webinar is on
January 28, 2021

*Improved Approaches for PFAS
Sampling and Treatment*



Survey Reminder

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

