The webinar will start momentarily....

Advanced UESC Training:
Day 2 - Technical Project Development and Implementation

August 11, 2022 | 1:00 PM - 4:00 PM (EDT)

U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Advanced Utility Energy Service Contract (UESC) Training

Day 2 - Technical Project Development And Implementation | August 11, 2022

FEMP Federal Energy Management Program

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- **Ensure your phone/computer is muted throughout the webinar**
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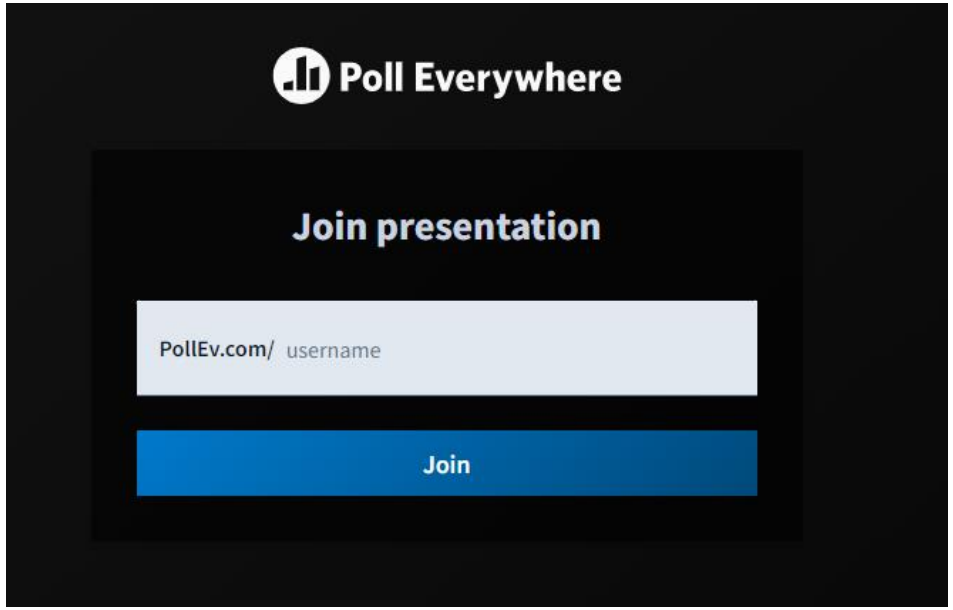
- **Questions will be addressed during Q&A breaks**
  - Send to all panelists in the Q&A window
  - Didn't have time for your question? Contact us through the FEMP Assistance Request Portal



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IACET-Certified Continuing Education Units (CEU)

To Receive IACET-Certified CEUs:

- **Attend the training in full–no exceptions**
- **Within six weeks of the training (before September 20!):**
  - Complete the assessment (a minimum score of 80% is required)
  - Complete an evaluation of the training

Access the UESC Training Assessment and Evaluation

Day 1 – https://www.wbdg.org/continuing-education/femp-courses/femplw08092022

Day 2 - https://www.wbdg.org/continuing-education/femp-courses/femplw08112022

For logistical questions related to the webinar or evaluation, email Elena Meehan at elena.meehan@ee.doe.gov.

Instructor Introductions

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Project Manager
NREL

FEMP Federal Energy Management Program | NREL NATIONAL RENEWABLE ENERGY LABORATORY

Training Recap

UESC Advanced Training Day 1 – Tuesday, August 9th

- Contracting officer responsibilities
- UESC pricing reviews
- Contract management

This webinar and training day 1 will be available as On-Demand Training on the Whole Building Design Guide website, along with many other UESC training courses.

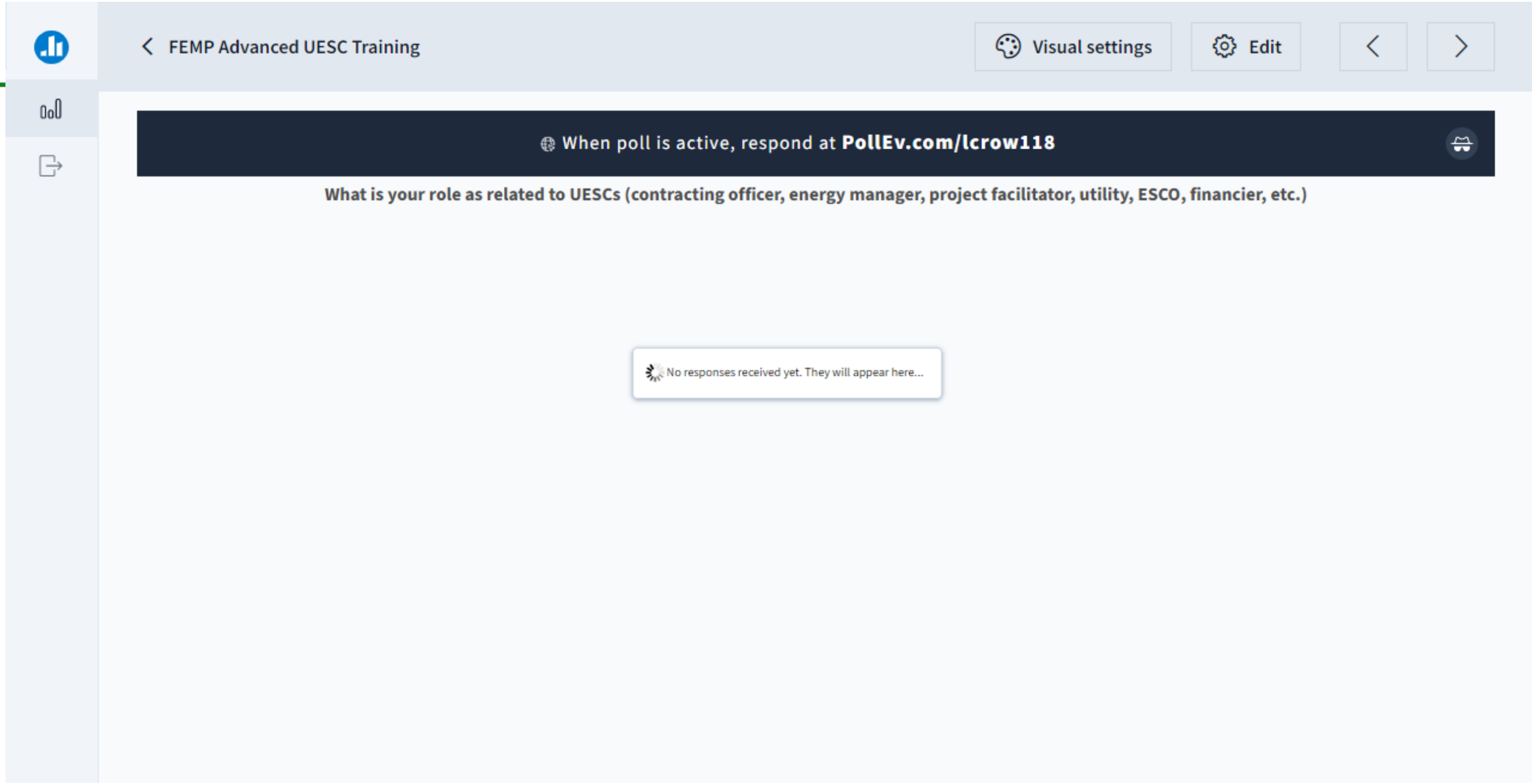
Training Agenda

- **Decarbonization considerations**
- **Project risks & mitigation strategies**
  - Project development
  - Implementation
  - Performance period
- **Q&A**
- **Performance assurance considerations**
  - Requirements
  - Recommendations
- **Final Q&A**
- **FEMP Resources**

Day 2 Objectives

Upon completion of this course, attendees will be able to:

- Develop strategies for identifying and mitigating project development, implementation, and performance risks;
- Recognize how commissioning, training, measurement and verification, and operations and maintenance planning impact performance assurance; and
- Utilize FEMP resources—tools, templates, training, and expertise—available for developing a UESC


FEMP Advanced UESC Training
Visual settings
Edit
When poll is active, respond at PollEv.com/lcrow118
What is your role as related to UESCs (contracting officer, energy manager, project facilitator, utility, ESCO, financier, etc.)
No responses received yet. They will appear here...

When poll is active, respond at **PollEv.com/lcrow118**

How much experience do you have with UESCs?

None | I'm familiar with UESCs but ha... | I've been involved in some cap... | I've been a contributor in mul...

Decarbonization Considerations

Federal Carbon Reduction Policy

Federal policies include:

- **E.O. 13990:** Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis
- **E.O. 14008:** Tackling the Climate Crisis at Home and Abroad
- **E.O. 14057:** Catalyzing America's Clean Energy Economy Through Federal Sustainability
  - E.O. 14057 (Section 102a) goals include:

100% carbon pollution free electricity (CFE) on a net annual basis by 2030 (incl. 50% 24/7 CFE)

100% zero-emission vehicle acquisitions by 2035

Net-zero emissions building portfolio by 2045

65% reduction in Scope 1 & 2 emissions by 2030

Implementing instructions from CEQ are forthcoming

Decarbonization Strategies

Strategy is unique to each site

- Primarily a function of on-site fossil fuel use (Scope 1)
- Influenced by serving utility's current and future generation mix (Scope 2)

Baseline Load

Optimized Load

Step One: Deep energy efficiency and load reduction.

- Lighting, boilers, chillers and load reduction
- When replacing inefficient fossil fuel-based equipment, begin with load reduction, then electrification and demand flexibility
- Avoid new long-lived fossil fuel burning equipment (boiler, etc.) when possible

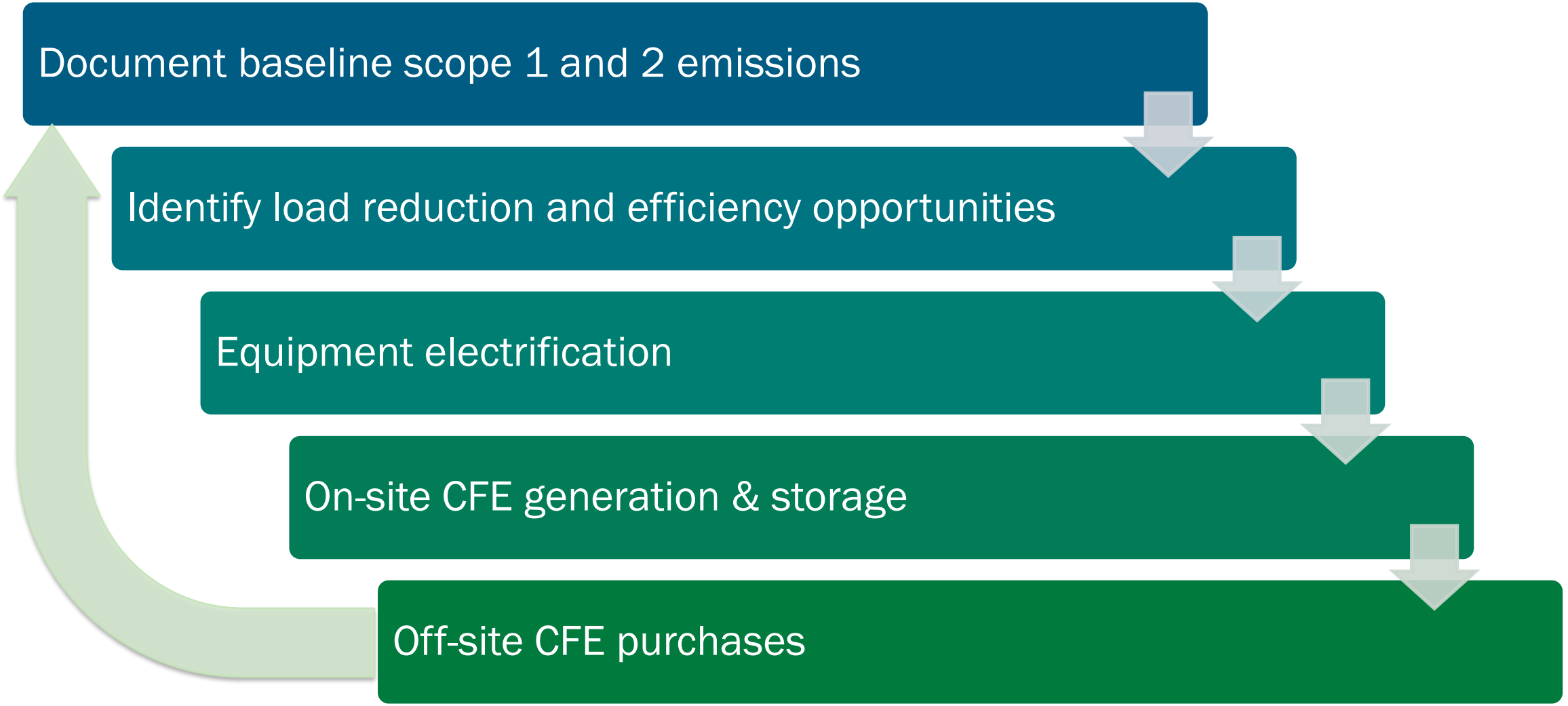
Step Two: Electrification (electric vehicles, heat pumps).

- Reduces emissions in most locations
- Largest reductions where current/future utility carbon emissions are relatively low

Step Three: On-site CFE generation / storage.

- Largest emissions reduction where current/future utility carbon emissions are relatively high

General Decarbonization Pathway



Decarbonization in Performance Contracting

Include agency decarbonization goals in Letter of Interest/Sources Sought Notice

- Consider deep energy retrofits, CFE, electrification, energy storage, water/wastewater conservation
- Include requirements in contractor selection criteria

- **In PA/IGA, contractor should evaluate low carbon/GHG emissions alternatives to typical ECMs**
  - Common examples: Heat pumps, heat recovery chillers, on-site CFE generation / storage
  - Consider ECM feasibility, cost, savings, O&M, carbon/GHG emissions reduction
  - Have key agency team members attend ECM workshops to understand cost-benefits of low carbon/GHG alternatives
- **Review current/future utility generation mix to determine most effective decarbonization opportunities**

Key Takeaways

Reducing site GHG emissions is achievable now

- Start with energy and water efficiency, load reduction
- Electrify where possible, considering utility grid carbon emissions
- Include on-site clean DE + storage

- **Be wary of "locking in" long term fossil fuel consuming equipment (i.e., replacing NG boilers with more efficient boilers)**
  - Cost-effective low-carbon alternatives are readily available
- **Comprehensive projects encouraged**
  - Bundling deep efficiency and low-payback ECMs can help cover longer-payback ECMs
  - Avoided costs for planned equipment replacements can be used to improve efficiency and/or switch to lower carbon options
  - Appropriations, grants, and other incentives may also be used

Decarbonization References

- **Better Buildings**
  - Decarbonizing HVAC and Water Heating in Commercial Buildings
- **GSA Green Building Advisory Committee**
  - Federal Building Decarbonization Task Group Advice Letter & Appendices

FEMP On-demand Training

Decarbonization Considerations: Performance Contracting

Decarbonization Considerations: Onsite Distributed Energy Projects and Offsite Purchases

Project Risks & Mitigation Strategies

Project Development Risk

How can we best set up a project for success?

Examples of project development risk that need to be addressed:

- Unfeasible or unfamiliar ECMs
- Portions of the work with a high potential for concealed conditions
  - Subsurface obstructions, groundwater, unknown hazardous materials, etc.
- Inaccurate baseline calculations or assumptions
- Poor stakeholder & development team coordination/communication
- Changes in site goals or needs throughout development period
  - Staff turnover, changes in site mission or building use, etc.

Project Development Risk Mitigation

ECM workshops including specific sections for design, installation, commissioning (Cx), M&V, O&M, and project scheduling

- ECM workshops should ensure stakeholder agreement during development
- Include subject matter experts when discussing new technologies or technically complex ECMs
- Detail in ECM workshops should increase as project development progresses
- ECM workshops should include scheduling and site-specific implementation considerations as well as:

Design
- Major equipment
- Operational strategies

M&V
- Overall strategy
- IPMVP/FEMP Options

Cx
- Field Performance Testing
- Point-to-point check outs

O&M
- Risk & responsibility matrix
- Maintenance requirements

Project Development Risk Mitigation

Early and often communication between agency, Utility, and ESCO partners

- Build a comprehensive team with lead points of contact clearly identified
- Where applicable, maintain open communication with any site/building tenants, considering how the project may impact their operations

Project Facilitators (PFs) are recommended but not required (check agency policy)

Project Development Risk Mitigation

Detailed pre-construction surveys & investigations

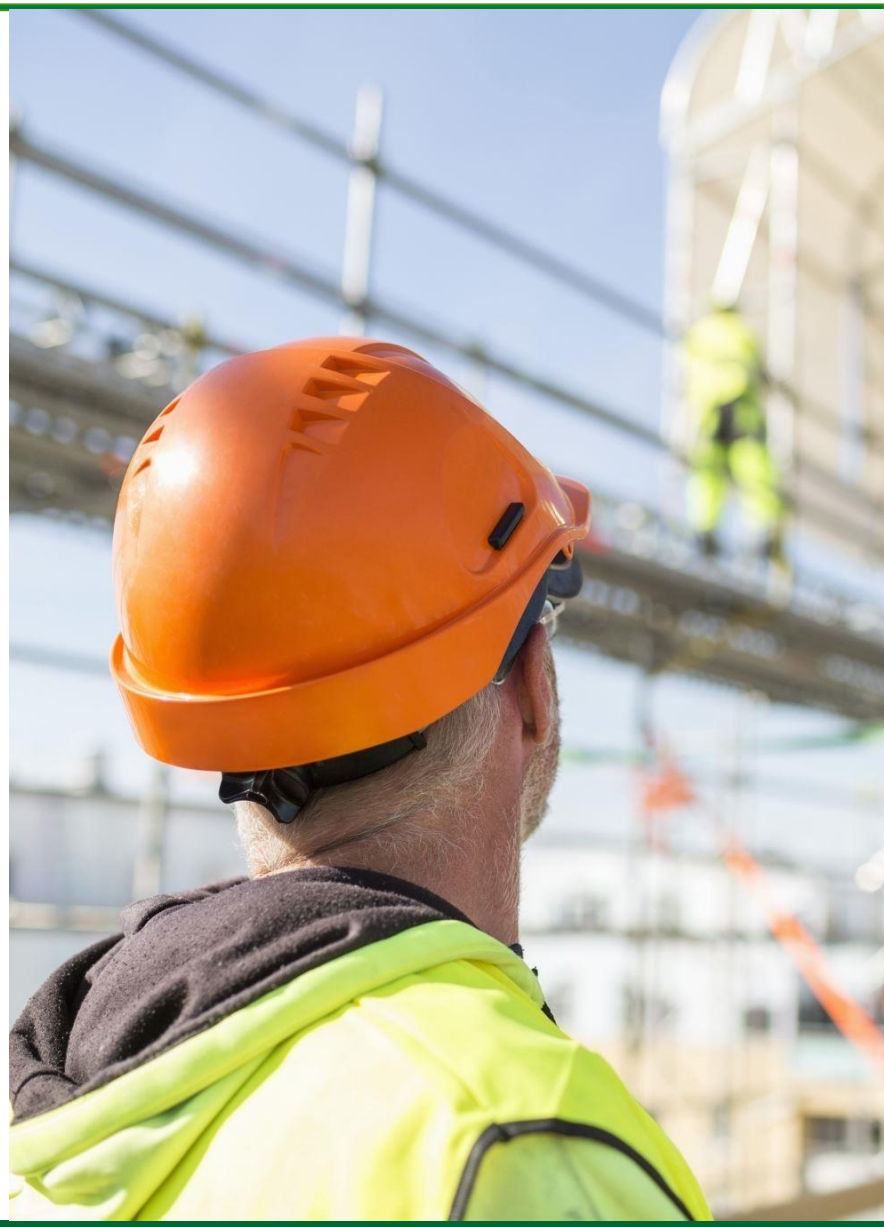
- Agency team should provide site plans, information, and specifications that are accurate to the best of their knowledge
- Any assumptions made in pre-construction surveys should be verified and agreed upon prior to moving forward with design
- If portions of the work have a high potential for concealed conditions, dedicate extra time to carefully investigate
  - Sample bore holes, additional testing for hazardous materials, ground penetrating radar surveys where appropriate

Detailed surveys in development can help reduce construction period issues!

Project Development Risk Mitigation

- **Baseline development**
  - Ensure all stakeholders agree with baselines and measurement techniques
  - After construction, baselines cannot be remeasured!
- **Continued stakeholder engagement at all levels, throughout the entirety of project development**
  - Last minute objections in the development phase can have large impacts on how a project progresses

Thorough project development will set a project up for success



Implementation Period Risk

How can we ensure the project is built in accordance with the design, specifications, and schedule?

Examples of construction period risk that need to addressed:

- **Construction delays**
  - Unrealistic construction timelines
  - Errors in implementation requiring rework
  - Current supply chain volatility
- **Inadequate/improper ECM & project acceptance criteria**
- **Building & site tenant communication**
  - ECM end-user understanding
- **General construction site safety**

Implementation Period Risk Mitigation

- **Use of critical path method scheduling and regular schedule updates**
  - Critical path method scheduling is necessary to conduct time-impact analysis
- **Ensure appropriate task duration estimation method is used**
  - Analogous, parametric, three-point estimating, etc.
  - All parties must participate in managing the agreed upon project schedule
- **Stakeholders should understand scheduling methodology used**
  - Utility and agency partners should ensure that any unique agency or site-specific considerations are reflected in the construction schedule
- **Minimize time between contract award and the purchase of long-lead time equipment**
  - Ensure equipment manufacturing and shipping times are included in schedule

Implementation Period Risk Mitigation

- **Regularly scheduled construction progress update meetings with key stakeholders**
- **Regular inspections of work site to confirm adherence to project specifications and safety standards**
  - Personnel conducting inspections should be knowledgeable of the type of work and systems that they're inspecting
- **Open, candid communication regarding daily construction operations**
  - This can build trust within the implementation team and help identify and solve problems before they become major issues
- **Strict adherence to task order (TO) terms & conditions and scope of work**
  - Changes must be negotiated and agreed to by the Contracting Officer (CO)

Implementation Period Risk Mitigation

Ensure work schedule is coordinated amongst all parties involved – agency, utility, ESCO, subcontractors, building tenants, site security personnel, etc.

Ensure all project acceptance deliverables are clearly defined and received prior to project acceptance, for example:

- As-built drawings
- Full installed equipment lists
  - Some agencies may require this in a specific format
- Spare parts with inventory
- Warranty letters
- Commissioning & post installation M&V reports (when applicable)

Implementation Period Risk Mitigation

Maintain a good faith working environment

- **Agency must comply with contract terms and conditions related to access and safety**
  - Ensure escort availability in accordance with TO terms and approved work schedules
- **Submittals and special work requests should be delivered and reviewed in a timely manner**

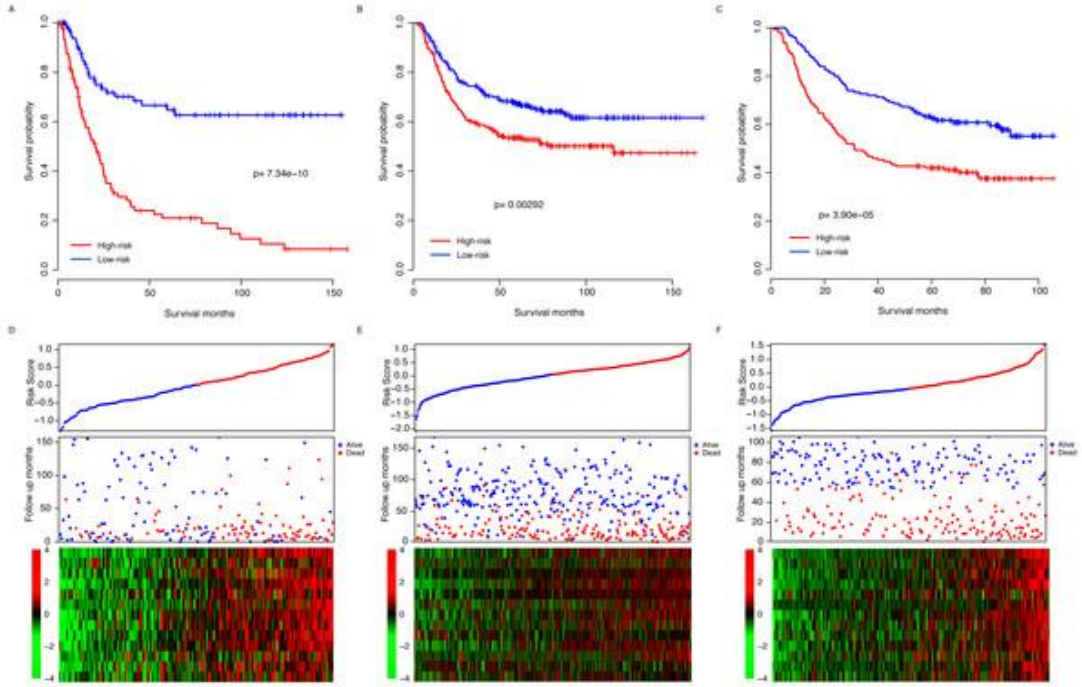
UESCs are long term partnerships!

Neither party will **intentionally prevent** the other from receiving the benefits of the project

Performance Period Risk

How can we sustain project performance throughout the life of the contract?

- **Performance Risk**
  - Installed equipment must operate in accordance with the design specifications
  - All space comfort needs of the building/site must be maintained
- **Savings Risk**
  - Are the expected electricity/gas/water savings being realized?



Performance Period Risk

Performance Risk

- Does a new boiler adequately heat your workspace?
- Is a new Building Management System providing adequate air flow in your workspace?

Savings Risk

- Is the new boiler using more natural gas than planned?
- Are new VFDs reducing fan speeds enough to consistently lower electricity usage?

Performance Period Risk Mitigation

Strategies for managing long-term contracts

- Early identification of potential issues is crucial
- Document & communicate major site or facility changes
  - Baseline adjustments as necessary
- Ensure all O&M/R&R activities are completed and documented appropriately
- Ensure project continuity throughout staff turnover
- Engagement with utility during all performance period activities

Document Management and Storage

- Automate reporting in central location for ease of long-term access to critical project data
- FEMP recommends eProject Builder

eProject Builder (ePB)

Secure web-based energy project tracking/reporting

- Follow your agency policy about using ePB
- Free tool maintained by LBNL for U.S. DOE
- ePB enables contractors and their customers to securely:
  - Preserve and track project information in perpetuity
  - Develop project scenarios using standardized calculations
  - Output financial schedules, M&V reports, analysis on portfolio of projects
  - Compare proposed projects against historical ones
- We recommend use of the ePB financial schedules for all projects, even if they are not reported in ePB

eProjectBuilder

eprojectbuilder.lbl.gov

Need Help?

epb-support@lbl.gov

On-Demand Training

ePB for UESCs: Enhancing Project Comprehension and Transparency with eProject Builder

Q&A

Don’t Hesitate to Ask Us Questions!

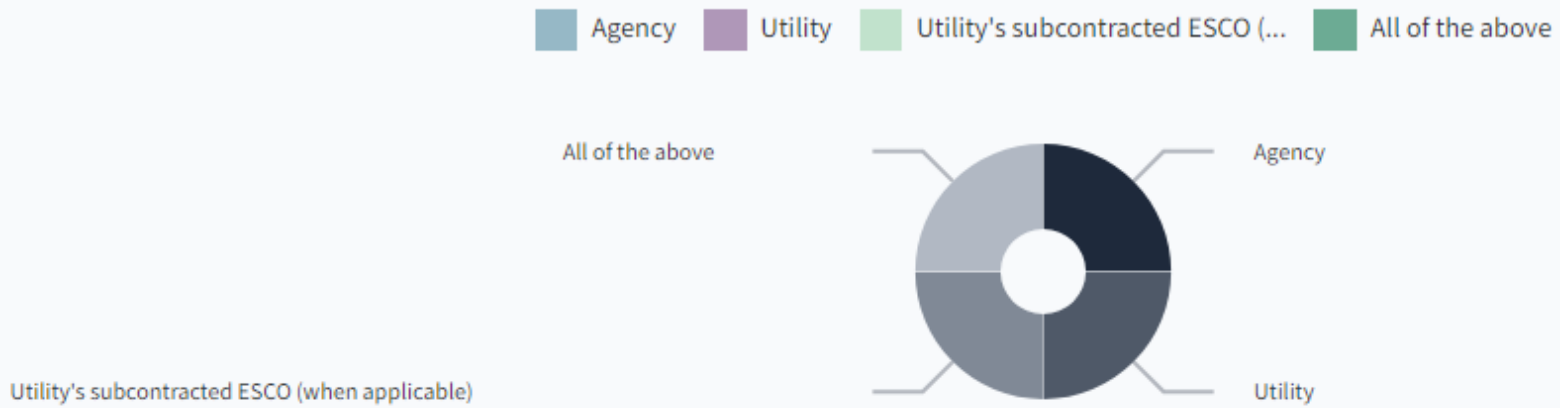
- Send questions to all panelists in the Q&A window
- Or submit your questions through the FEMP Assistance Request Portal

Enjoy the Break!

(We'll resume shortly)

When poll is active, respond at **PollEv.com/lcrow118**

A complete UESC team includes stakeholders from which of the following groups:



When poll is active, respond at **PollEv.com/lcrow118**

Which of the following is NOT a recommended project risk mitigation strategy?

Maintain open, candid communic...

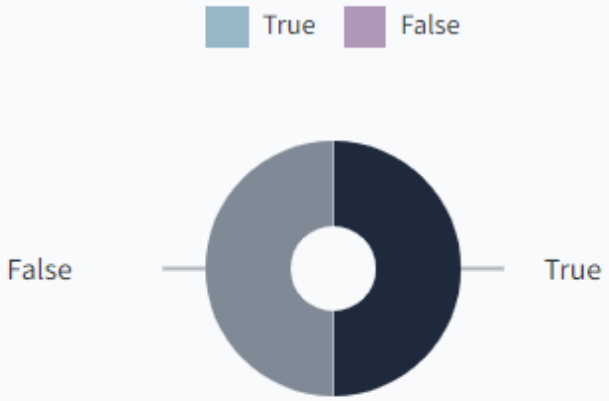
Hold regular construction prog...

Regularly review and assess im...

Ignore small problems until th...

When poll is active, respond at **PollEv.com/lcrow118**

The agency is responsible for coordinating UESC implementation period activities with their building tenants and site staff:



Performance Assurance Planning

Performance Assurance Plan – Definition

A Performance Assurance Plan is the collection of ECM specific sub-plans, instructions, and schedules, that are essential to establishing, verifying, and sustaining performance over the operational life of an ECM

- Deliverables should be submitted iteratively, with increasing levels of detail and specificity as the project progresses
- All assumptions made in early-stage deliverables shall be confirmed and agreed to by all project stakeholders prior to finalizing the contract & design

42 U.S.C. § 8253 (f)(5) Follow-up on Implemented Measures

For each measure, Energy Managers shall ensure that:

A. Equipment, including building and equipment controls, is fully **commissioned** at acceptance to be operating at design specifications

B. A plan for appropriate **operations, maintenance, and repair** of the equipment is in place at acceptance and is followed

C. Equipment and **system performance measured during its entire life** to ensure proper operations, maintenance, and repair

D. Energy and water **savings are measured and verified**

Reference: UScode.house.gov

Recommended Performance Assurance Plan Deliverables

1. **Energy use baselines** for each ECM
2. **Engineering and design** showing assumptions, preliminary calculations, design specifications, operational strategies, and performance metrics for each ECM
3. **Comprehensive training plan** for Agency staff, covering each ECM
4. **Operations, maintenance, repair, and replacement plan** that will support equipment performance throughout the contract term
5. **Commissioning plan** that will demonstrate all installed equipment operates as designed
6. **Measurement and verification plan** to confirm equipment is performing as expected, in comparison with established baselines

Agency Witnessing Best Practices

- **Designate a knowledgeable government witness to accompany the utility/ESCO throughout the project**
  - Designate multiple people with different areas of expertise when needed
- **Take a graded approach focused on:**
  - Degree of performance risk of the ECM
  - Critical construction activities (rigging, testing, concrete pours, startup, etc.)
  - ECMs on critical systems (e.g., data centers)
  - Proper measurement sampling of ECMs such as lighting, motors, VFDs
- **Document all witnessing activities**

- ✓ Baseline development
- ✓ Construction
- ✓ Commissioning
- ✓ M&V activities

FEMP Guide to Government Witnessing

Energy Use Baselines

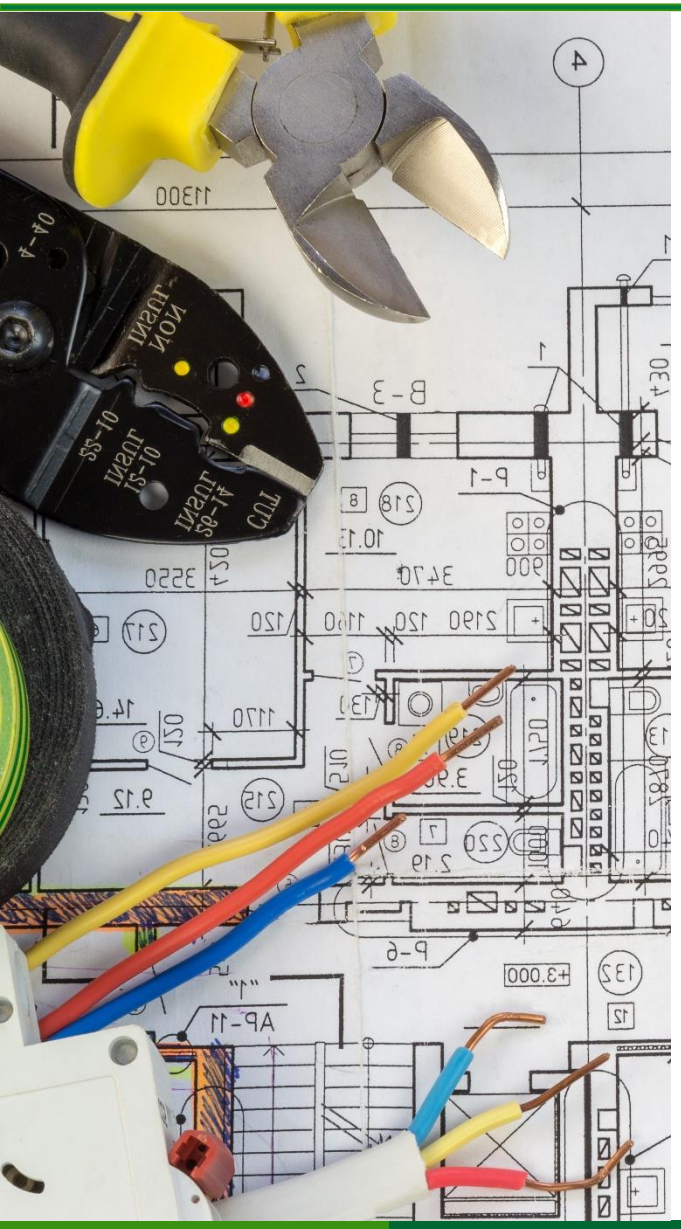
- **Baselines are estimated in the PA based on:**
  - Visual inspection of equipment
  - Information from energy manager and O&M staff
  - Utility data
- **Baselines are defined during the IGA based on:**
  - Energy and water use and cost
  - Measured performance and usage of equipment
  - Verified O&M practices and costs
  - Facility operations
- **Baselines must be accurate and documented**

Energy Use Baselines

- **Allow the utility/ESCO full, unrestricted discovery**
  - Utility & ESCO need all information necessary to develop accurate baselines
- **How are baselines going to be calculated**
  - Field measurement?
  - Utility bill analysis?
  - Equipment size/load vs. occupancy schedules?
    - Lighting ECMs for example
- **Stakeholder witnessing and agreement on baseline calculations**
- **Baseline calculation method should be complimentary to M&V option chosen for each ECM**

Baseline conditions cannot be measured after project implementation!

Engineering & Design



- **Preliminary assessments typically investigate ECM feasibility**
- **IGA typically calls for ~35% design**
- **Level of detail required in IGA will vary depending on the intricacy of the measure**
  - Lighting or other 1:1 replacement or audit-based ECM may be relatively simple
  - CHP installation may have general arrangements and equipment schedules
  - EMCS/BAS upgrades may include elements of both
    - Lists of equipment to be replaced (motors, drives, controllers, etc.)
    - Proposed occupancy schedules, setpoints, and sequences of operation
- **Designs should be detailed enough for accurate, competitive subcontractor bidding and confidence that desired performance & savings are achievable**

Comprehensive Training Plans

- **What to expect in the training plan**
  - Classroom & field training agendas
  - Manufacturer equipment operations literature and maintenance schedules
- **What to expect during construction**
  - Coordination with on site O&M team to schedule training
    - Accounting for split shifts and rotating schedules
- **Prior to project acceptance**
  - Recordings of classroom training sessions
  - Full lists of installed equipment and spare parts
- **Performance Period**
  - Retraining as needed and agreed upon

Operations, Maintenance, Repair, and Replacement Plan

- **What to expect**
  - OMR&R plan assigns responsibility for operations, maintenance, repair, and replacement of new equipment after ECM and project acceptance
  - Equipment operational manuals, manufacturer's recommended preventative maintenance procedures and schedules, warranty information, etc.
  - Responsibilities should be negotiated and agreed upon prior to Task Order award
- **Agencies should only accept OMR&R responsibilities that they can support**
  - If a new technology is being introduced to a site, if there are historic problems with deferred maintenance, or staffing issues, the agency should consider giving more OMR&R responsibly to the utility or ESCO
  - Follow agency standards & guidance

Operations, Maintenance, Repair, and Replacement Plan

- **OMR&R can differ greatly between ECMs**
  - For example, lighting OMR&R will differ greatly from cogeneration OMR&R
    - Lighting may include handover of attic stock for agency personnel to hold and install if any lamps or ballasts go bad (after the warranty period)
    - Cogeneration should include regular preventative maintenance and testing, qualified operators (from the utility, ESCO, or agency), a wide variety of spare parts held on site, etc.
- **Recommend establishing OMR&R responsibilities for each ECM clearly in a risk & responsibility matrix**
  - Matrix should include enough specific detail to prevent confusion of responsibility and lapses in O&M coverage

Commissioning

- **Commissioning (Cx)**
  - The systematic process of ensuring that all systems perform in accordance with the design and the operational needs of the facility, using appropriate testing, verification, and documentation
- **Recommissioning (RCx)**
  - Additional Cx processes, typically triggered by a change in building use or the onset of operational issues, focused on ensuring continued performance of that building or system
  - The initial Cx process should include a RCx plan that includes trigger definition
- **Retro Commissioning (Retro-Cx)**
  - Applying the Cx process to existing buildings or systems that have not previously been commissioned

Commissioning (continued)

- **Monitoring-Based Commissioning (MBCx)**
  - Also referred to as Ongoing Commissioning
  - A continuous application of the Cx process
  - MBCx software tools analyze building automation and metering data to identify potential performance improvements and assess impacts of changes made within the building or system

FEMP Technical Report
Enhancing Performance Contracts with Monitoring-Based Commissioning

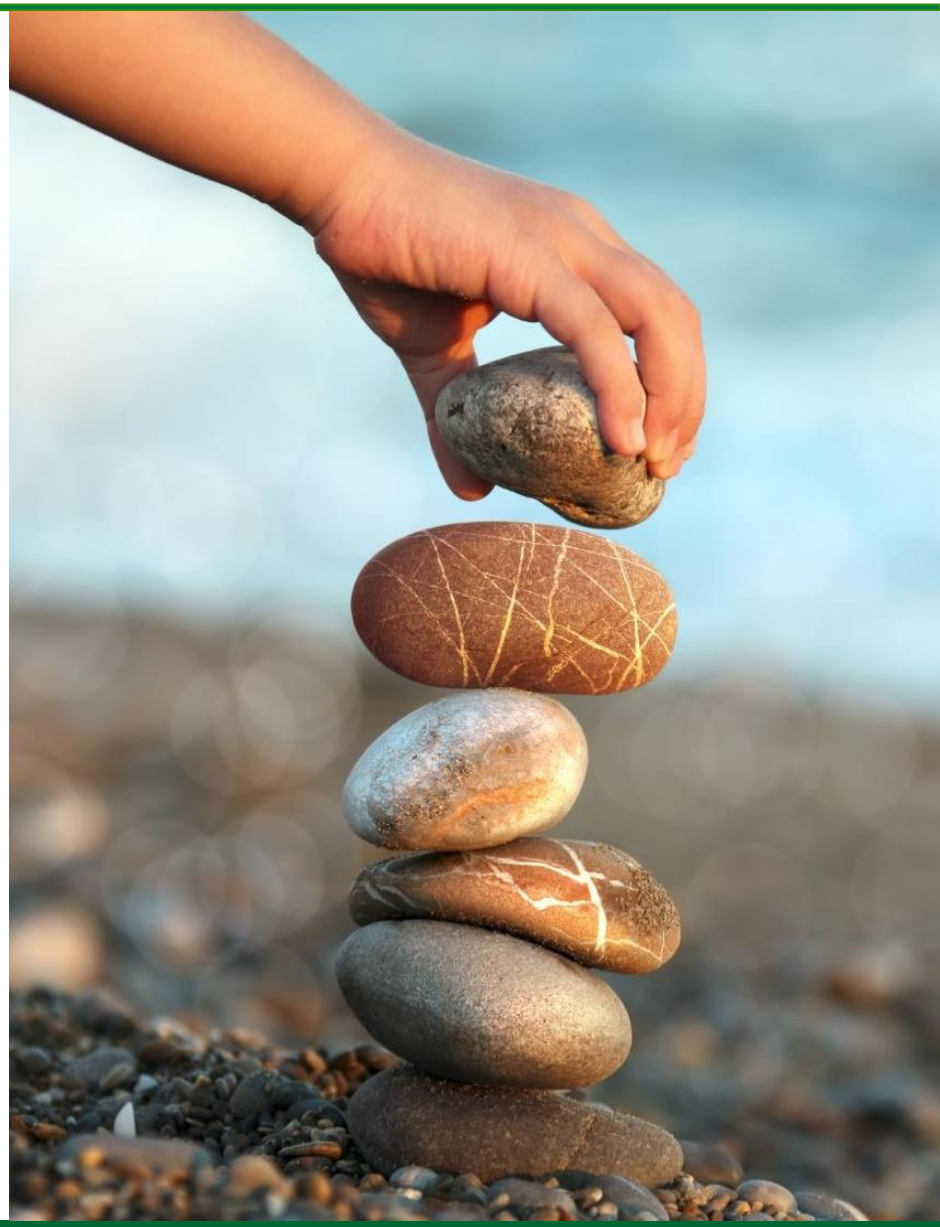
FEMP On-Demand Training
Monitoring-Based Commissioning in Performance Contracting

Commissioning (continued)

- **What should be included in the Cx plan**
  - Overall Cx strategy including planned onsite presence (utility/ESCO internal or 3rd party Cx agent), timelines, intended Cx workshops, and recommended agency witnessing
  - Where applicable, the plan should include ECM key performance indicators, occupancy schedules, setpoints, and sequences of operation
  - Field performance test and point-to-point checkout templates should be available for each ECM
    - Site specific details should be prepared in conjunction with the final design
- **Outcome from Cx**
  - Punch lists (when needed)
  - Commissioning report

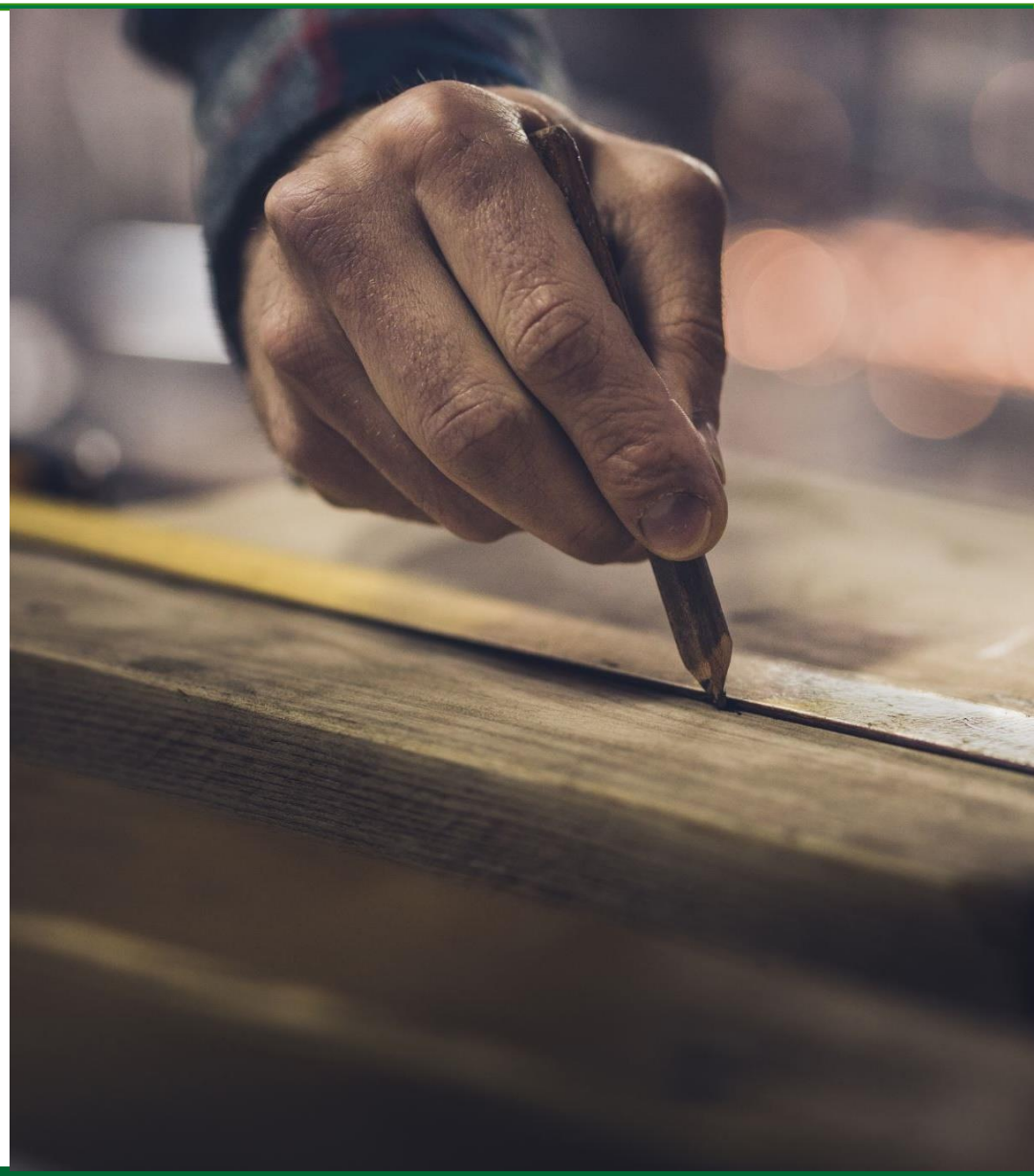
Measurement & Verification

- **Definition**
  - M&V is the process of quantifying energy savings resulting from improvements made to energy-consuming systems
- **When properly planned & applied, M&V can:**
  - Accurately assess & help with monitoring ECM performance
  - Reduce risk of lapses in equipment performance
  - Inform O&M processes
- **M&V plan should balance the cost to execute the plan with the value added by increasing certainty of ECM performance**



Measurement & Verification in UESCs

- **UESC requirements**
  - Per 42 USC 8253(f)(5)(c) and (d)
  - Equipment and system **performance** must be measured during its entire life to ensure proper operation, maintenance, and repair
  - Energy and water savings are **measured and verified**
- **Proven M&V methods are commonly used to verify ECM performance**



Commissioning vs. Measurement & Verification

- **Commissioning is focused on equipment operation with respect to design intent and the building's needs.**
  - Confirms that ECMs have been installed and programmed correctly and are utilizing proper (agreed upon) control schemes (schedules, heating & cooling setpoints, light levels, etc.)
- **M&V is focused on demonstrating that ECMs are performing as expected with respect to energy use**
  - UESCs are performance contracts

Commissioning vs. Measurement & Verification

Commissioning

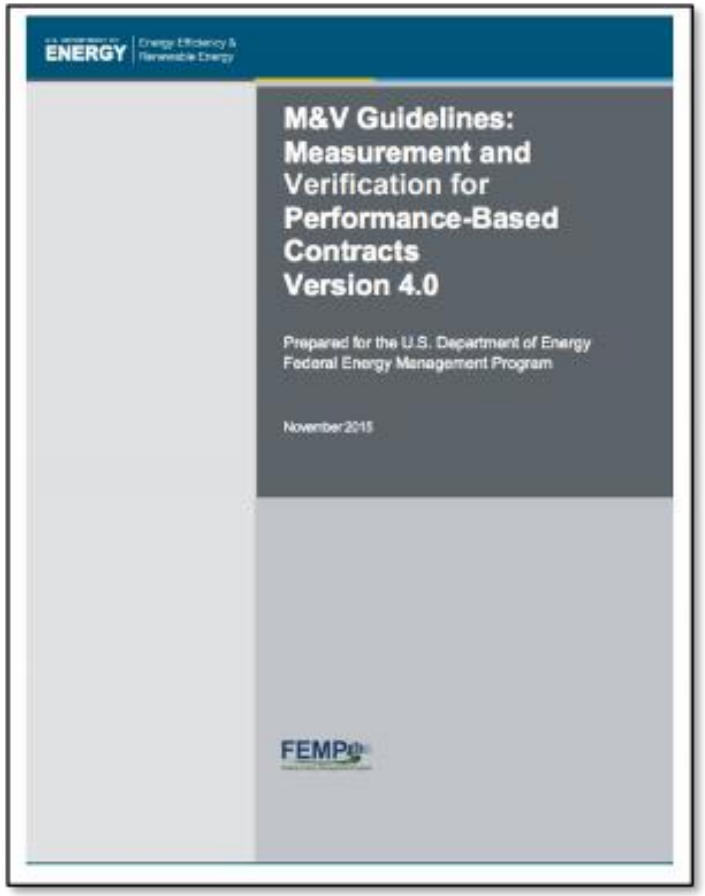
- Can a new boiler generate adequate levels of steam?
- Can a new chiller cool supply water to necessary temperatures?
- Are VFDs properly modulating fan speed as commanded by the control system?
- Confirm light levels in office spaces are appropriate

Measurement & Verification

- What is the verified electricity use by ECM, pre- and post- installation?
- Comparing pre- and post-installation measurements, you can quantify energy (or water) savings

FEMP Guidance on M&V

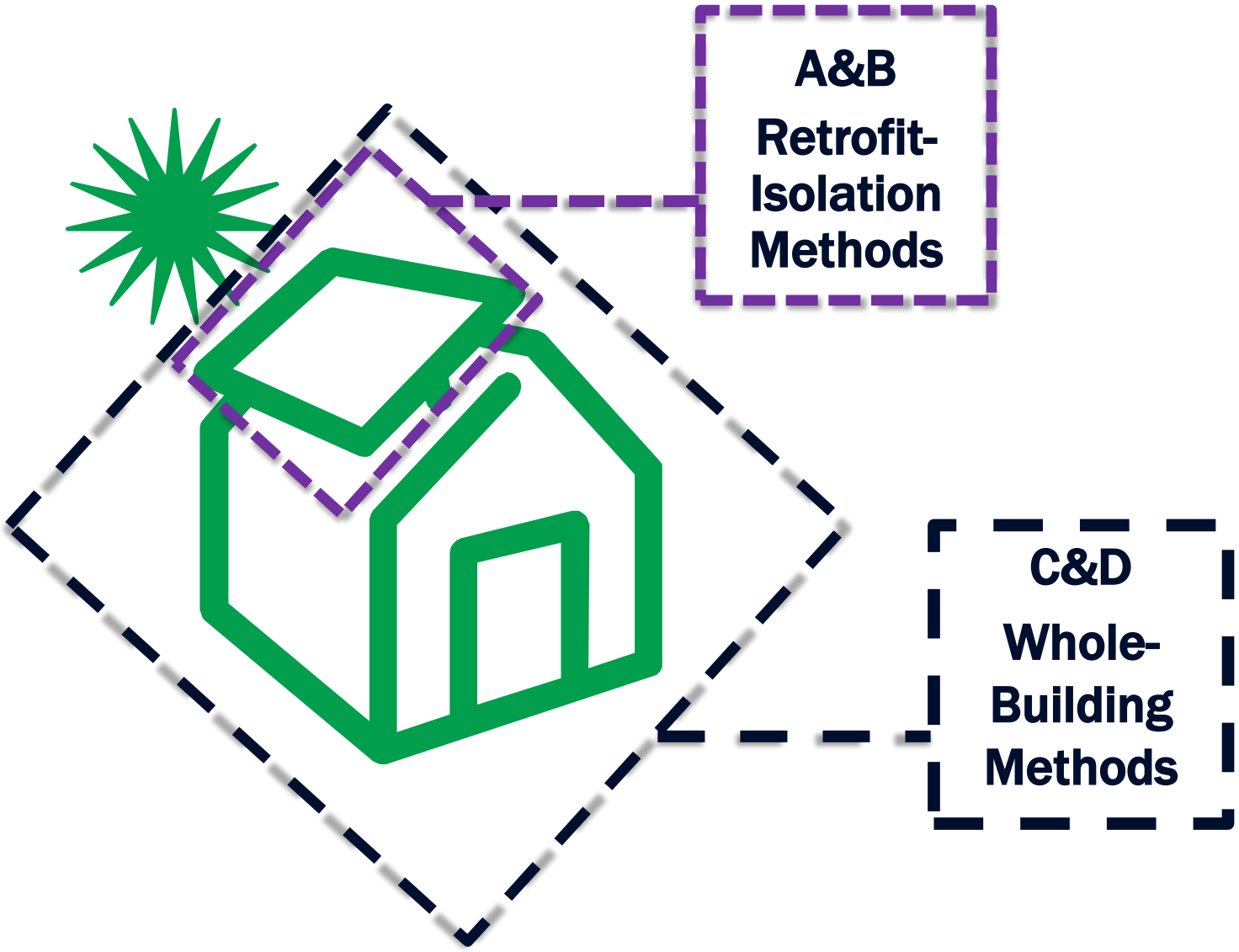
- ***M&V Guidelines: Measurement and Verification for Performance-Based Contracts Version 4.0 (2015)***
  - On FEMP ESPC Resources webpage
  - Application of Efficiency Valuation Organization's (EVO) *International Performance M&V Protocol* (IPMVP)
- **Overview of M&V process**
  - M&V plan, annual M&V, etc.
- **M&V risk and responsibility**
- **M&V options (A, B, C, D)**
- **Guidance for specific ECMs**



FEMP M&V Options

- **Each ECM is assigned an M&V option**
- **Measurements differ by:**
  - Level, frequency, duration
  - Whether key values are agreed to without performance period measurement
    - Example: Operating hours
- **Expense for typical projects**
  - Up-front expense averages less than 1% of project investment
  - Annual expense averages about 2.5% of annual savings

Options A & B vs. Options C & D



Option A – Retrofit Isolation, Key Parameter Measurement

Option A	Option B	Option C	Option D

- **Energy savings are determined by key parameter measurement, usually equipment performance, pre- and post-installation**
  - Option A is not limited to only one parameter if measurement of multiple parameters makes sense for the specific project/ECM
- **Simplest approach, lowest cost**
- **Usage parameters often measured before installation, and then agreed on for contract term, e.g., building occupied time per day**
- **Used where the "potential to perform" needs to be verified but accurate savings estimation is not necessary**
- **Option A is NOT "stipulated savings"!**

Option A – Lighting Upgrade

Baseline, Post Installation	Performance Period (Recommended Annually)
Measurements: • Fixture wattage (sample) • Operating hours (data logging or est. – *baseline only*) • Lighting levels (sample)	**Measurements:** None • Inspection of equipment - lamps still low wattage? • Lighting controls still working?
Savings Calculation: kW * hours; compare kW before vs. after	**Savings Calculation:** None, inspections only
Witnessing: sample of fixture power measurements	**Review and Witnessing:** review data collection forms, verifying equipment operational and lamp wattage correct
Energy-related Cost Savings: document past costs for lamps, ballasts, recycling/disposal	**Energy-related Cost Savings Review:** Verify that savings persist, and warranty procedures are followed

Option A – Boiler Upgrade

Baseline, Post Installation	Performance Period (Recommended Annually)
Measurements: • Baseline load – from logs/EMCS/meter • Measure boiler efficiency	**Measurements:** • Boiler (combustion) efficiency
Savings Calculation: Baseline load of boilers at efficiency before vs. after	**Savings Calculation:** None; verify that efficiency is still above post-install calculation assumption
Witnessing: correct logs/EMCS/meter data provided; optional -- boiler efficiency measurements	**Review and Witnessing:** review data collection forms; optional -- boiler efficiency measurements
Energy-related Cost Savings: if applicable, document past or anticipated costs	**Energy-related Cost Savings Review:** review annual O&M activities; verify that estimated maintenance costs not exceeded

Sources of Data for Fixed Parameters

Option A | Option B | Option C | Option D

Acceptable

- Measurements
- Engineering analysis
- Measurement-based models
- Manufacturer's data
- Standard tables
- TMY weather
- ANSI/AHRI/ASHRAE
- Facility logs

Unacceptable

- Undocumented assumptions
- Proprietary algorithms
- Unsupported handshake agreements
- Guesses at parameters
- Models based on questionable data
- Other buildings

Option B – Retrofit Isolation, All-Parameter Measurement

Option A | **Option B** | Option C | Option D

- Savings are determined by periodic or continuous measurement of all relevant parameters
- Measurement frequency should be consistent with expected variations
  - Seasonal operational changes, for example
- Applicable where highly accurate savings estimate sought, usually over the long term
- Appropriate when variables affecting energy use are not complex or difficult/expensive to monitor
- Reduces uncertainty compared to Option A, but requires more effort

Option B – Chiller Upgrade

Baseline, Post Installation	Performance Period (Recommended Annually)
Measurements: (all key parameters) • Chiller demand (kW) and energy use (kWh) • Chilled water load profile (tons) • Chilled water supply/return water temps • Pump/cooling tower kW/kWh (if affected) • Detail assumptions: weather, operating schedule, peak building demand	**Measurements:** • Same measurement of key parameters (possibly excepting load profile) as performed at post-installation M&V
Usage Calculation: Chiller performance (kW/ton) across range of operating conditions; extrapolate short-term measurements to annual profile for baseline	**Savings Calculation:** Savings calculated using same measurements as post install and applied to baseline profile
Witnessing: Correct logs/EMCS data used in baseline; optional – measurements of key parameters	**Review and Witnessing:** Data collection forms; optional – measurements of key parameters
Energy-related Cost Savings: If applicable, document past or anticipated costs	**Energy-related Cost Savings Review:** review annual O&M activities; verify that estimated maintenance costs not exceeded

Option C – Whole-Building Measurement

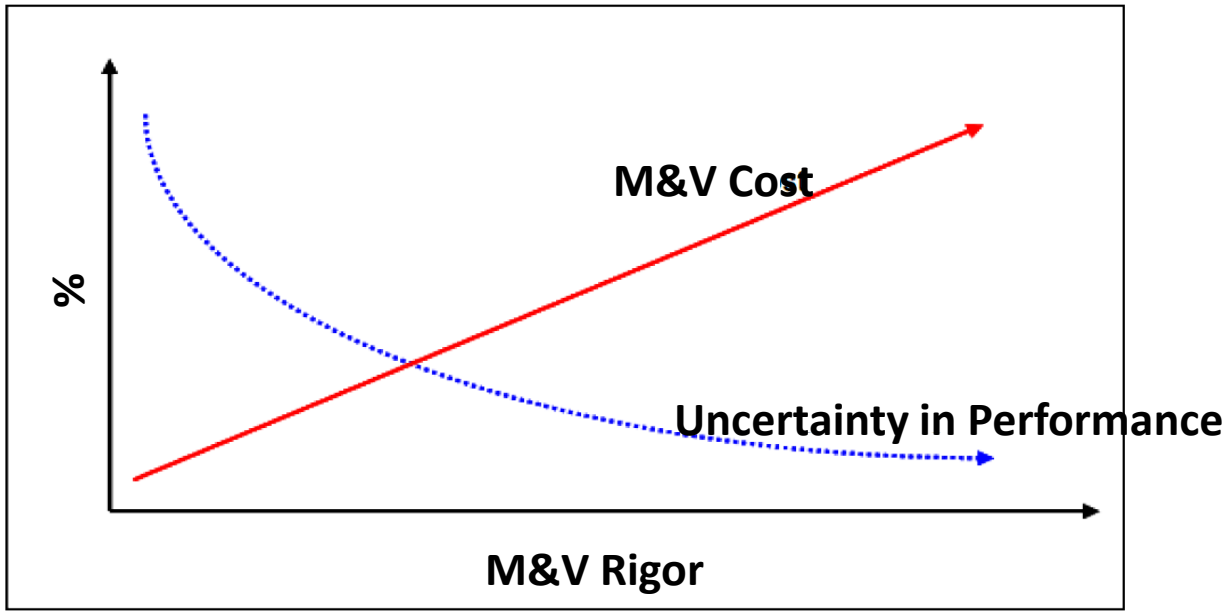
- Option C looks at energy use of an entire building or metered facility, not specific ECMs, with adjustments for weather & other factors
- Can be used on individual utility (e.g., electric or gas)
- Simple before/after utility bill comparison is insufficient
  - Important that savings > noise, so predictive model important
  - Accounts for weather and sometimes other usage factors
- Helpful where ECMs are highly interactive
- Generally best for just first 2-3 years, then switching to Option A or B

Option D – Calibrated Simulation

- **Option D entails computer modeling of an entire building**
- **Requires significant effort and expertise**
  - Ensure PF or agency has access to expertise
  - FEMP may be able to assist
- **Model calibrated with measured data**
- **Applications:**
  - New construction
  - Full building EMCS/BAS
  - Envelope (e.g., windows) or use changes
- **In projects using Option D, also consider Monitoring-Based Commissioning**

M&V Summary

- **Application of the plan**
  - M&V in a UESC can be used to verify ECM performance and savings
  - M&V plan needs to balance cost of executing the plan with value added by increasing certainty of ECM performance
  - Target most complex or largest savings contributors for more rigorous M&V approach
    - Helps balance M&V cost, savings uncertainty, and risk mitigation



M&V Resources

- **FEMP M&V Guidelines: Measurement and Verification for Performance-Based Contracts, Version 4.0**
  - Version 5.0 currently under development
- **International Performance Measurement & Verification Protocol (IPMVP)**

FEMP On-demand Training

Advanced M&V On-Demand Training

(Specific to ESPC but can be utilized in UESC)

Performance Assurance Element Interaction

All elements of the Performance Assurance Plan are complementary

- **Measurement & verification may help focus O&M efforts**
- **Regular, consistent O&M may identify the need for RCx**
- **Comprehensive training will allow the agency to perform thorough O&M**
  - Even if the agency is not fully responsible for O&M, better knowledge of their new systems will only benefit the entire team
- **Baselines set a standard for M&V to compare against and can be used as a reference point in O&M**

Actionable performance assurance plans greatly reduce performance period risk!

Other Performance Assurance Considerations

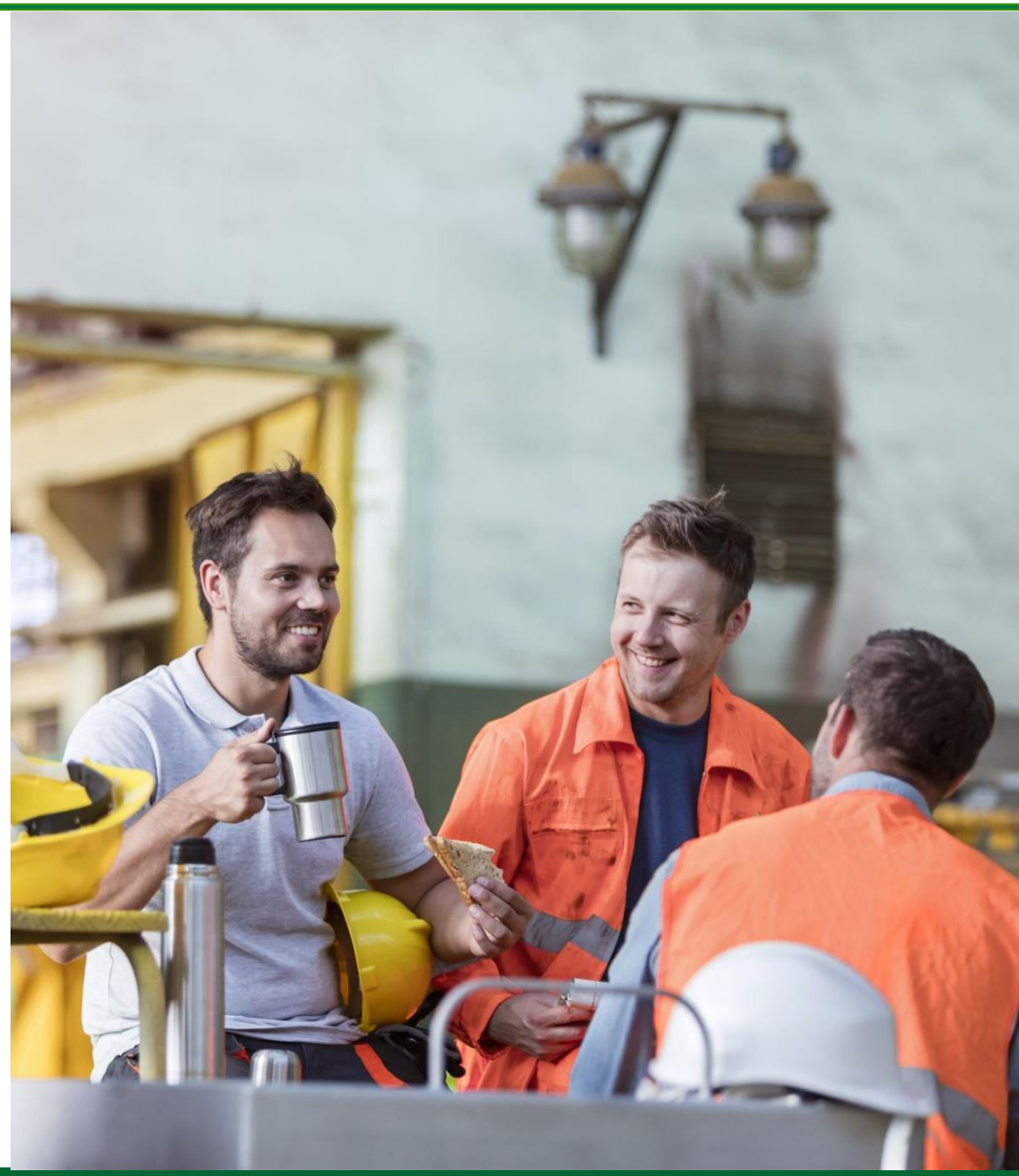
- **Performance Assurance Plan format/deliverable structure**
  - Dependent on agency requirements and development timeline
  - Anecdotally, the most successful projects we see have detailed, actionable performance assurance plans
- **Special operational needs for unique buildings & spaces**
  - Laboratories & data centers
  - Kitchens & dining halls
  - Museums
- **Building tenant influence on performance assurance**
  - One off schedule or setpoint change requests that would not prompt baseline adjustments

Energy Efficiency in Data Centers

FEMP Smart Labs

Lessons Learned: Savings Impacts

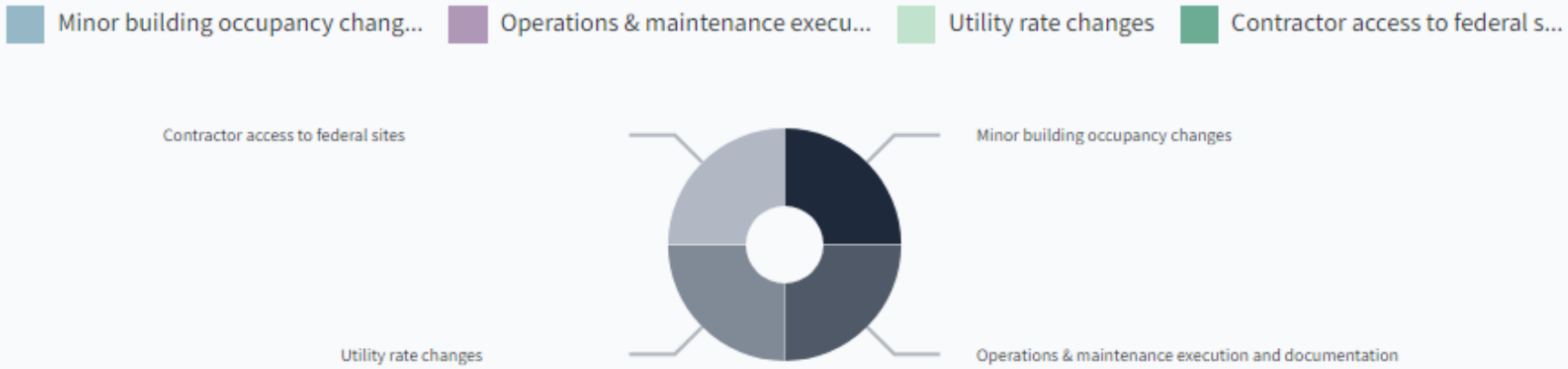
- **Key contributors to savings impacts:**
  - Schedule overrides or changes
  - Manual override of VFDs
  - Temperature setpoint changes
  - Deferred steam trap repair/replacement
- **Ensure O&M performed per TO**
  - Document all O&M, R&R activities
- **Options to address O&M**
  - Utility performs tasks
  - Agency performs tasks
    - *Agency should only accept responsibilities they can handle!*



Questions?

When poll is active, respond at **PollEv.com/lcrow118**

Which of the following presents the largest opportunity for performance period risk?



When poll is active, respond at **PollEv.com/lcrow118**

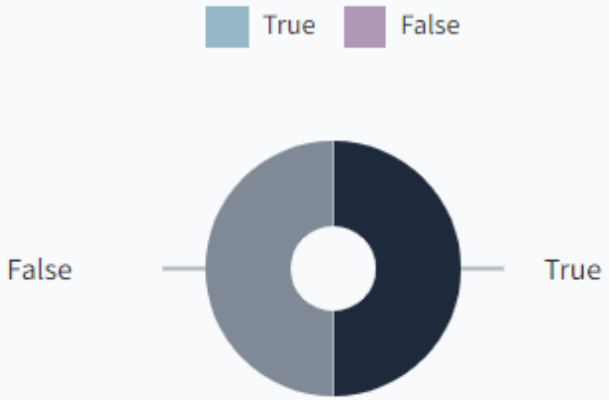
Which organization is responsible for operations & maintenance of equipment installed during a UESC?

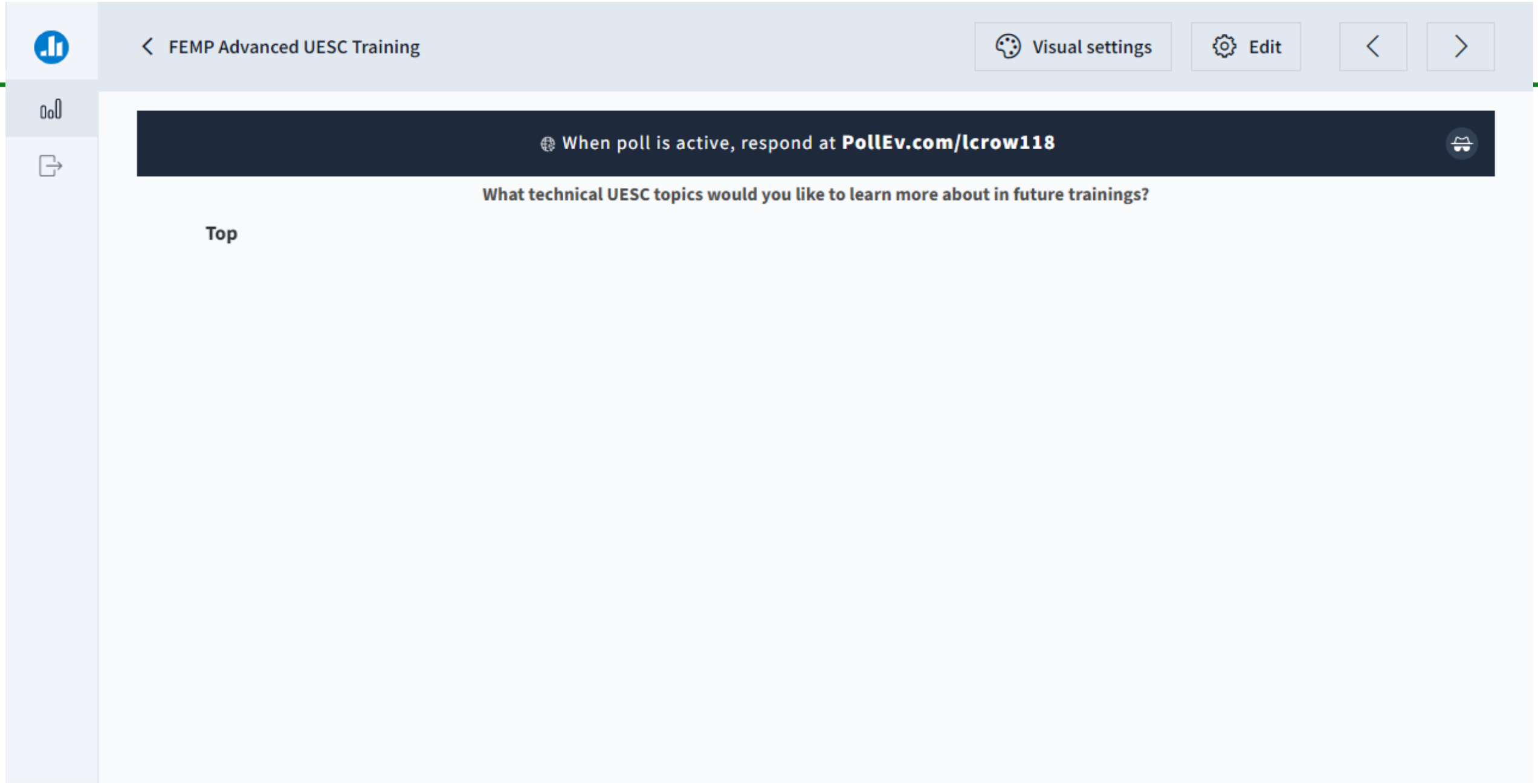
Utility | Utility's ESCO | Agency | This is task order specific. I...

This is task order specific. It should be agreed upon on during project development and shown in a risk & responsibility matrix

When poll is active, respond at **PollEv.com/lcrow118**

Agency witnessing of equipment commissioning is strongly recommended.




FEMP Advanced UESC Training
Visual settings
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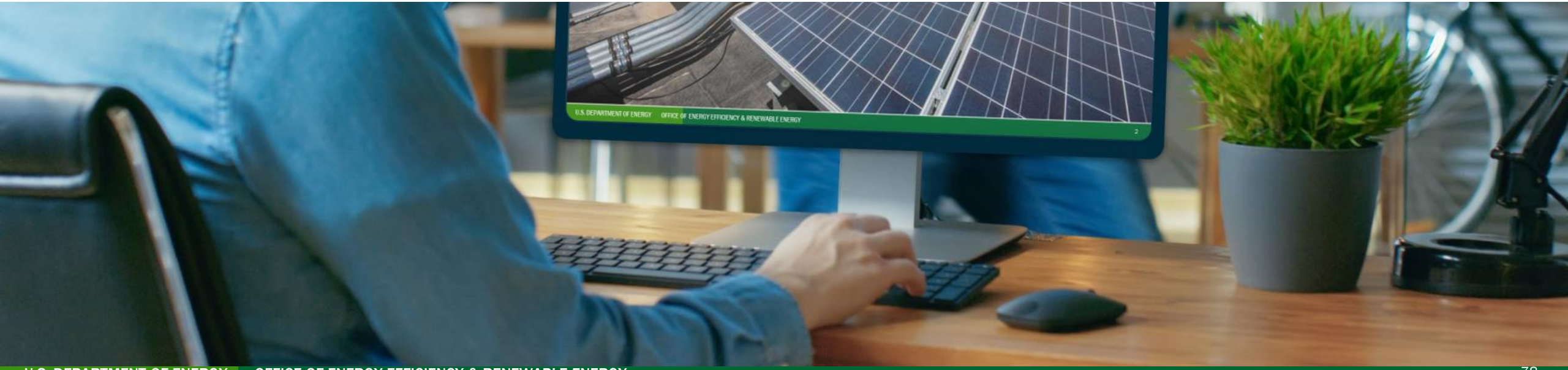
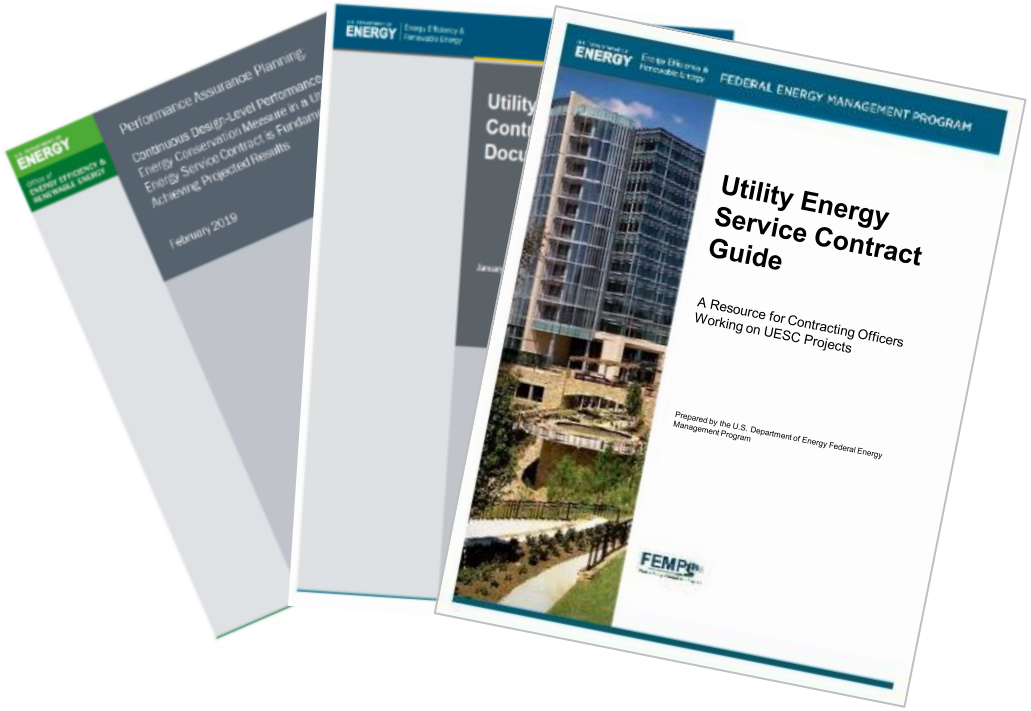
When poll is active, respond at PollEv.com/lcrow118
What technical UESC topics would you like to learn more about in future trainings?
Top

FEMP Resources Review and Project Support



UESC Resources and Support

- **UESC Website** – access everything from resources to case studies and webtools
- **UESC Project Development Resources** – downloadable guides, templates, and tools listed by topic and project phase
- **On-Demand Training** – learn at your own pace (CEUs available)
- **Step-by-Step Implementation Process**



FEMP Support and Technical Assistance

FEMP provides UESC training and project support at no cost to federal agencies:

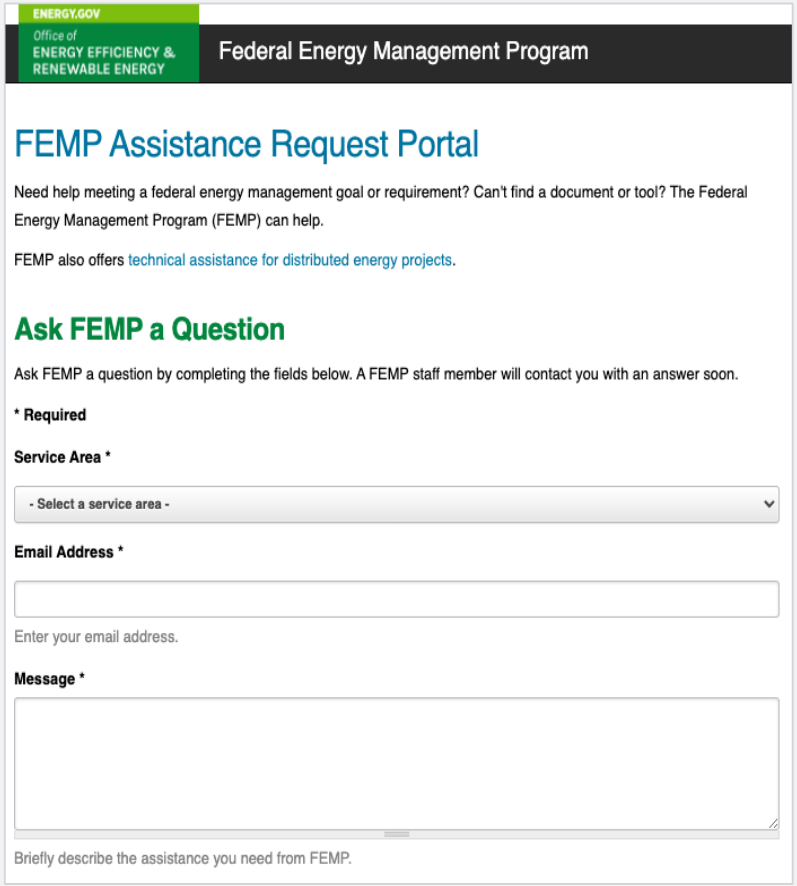
- Project guidance and discussions with Federal Project Executives (FPEs)
- Tailored training for federal agencies and utilities
- Technical assistance provided by DOE National Labs
- Federal Utility Partnership Working Group
- Strategic Partnership Meetings with utilities

Learn More

Download Scope of Support Document

FEMP Assistance Request Portal

Submit questions and support requests



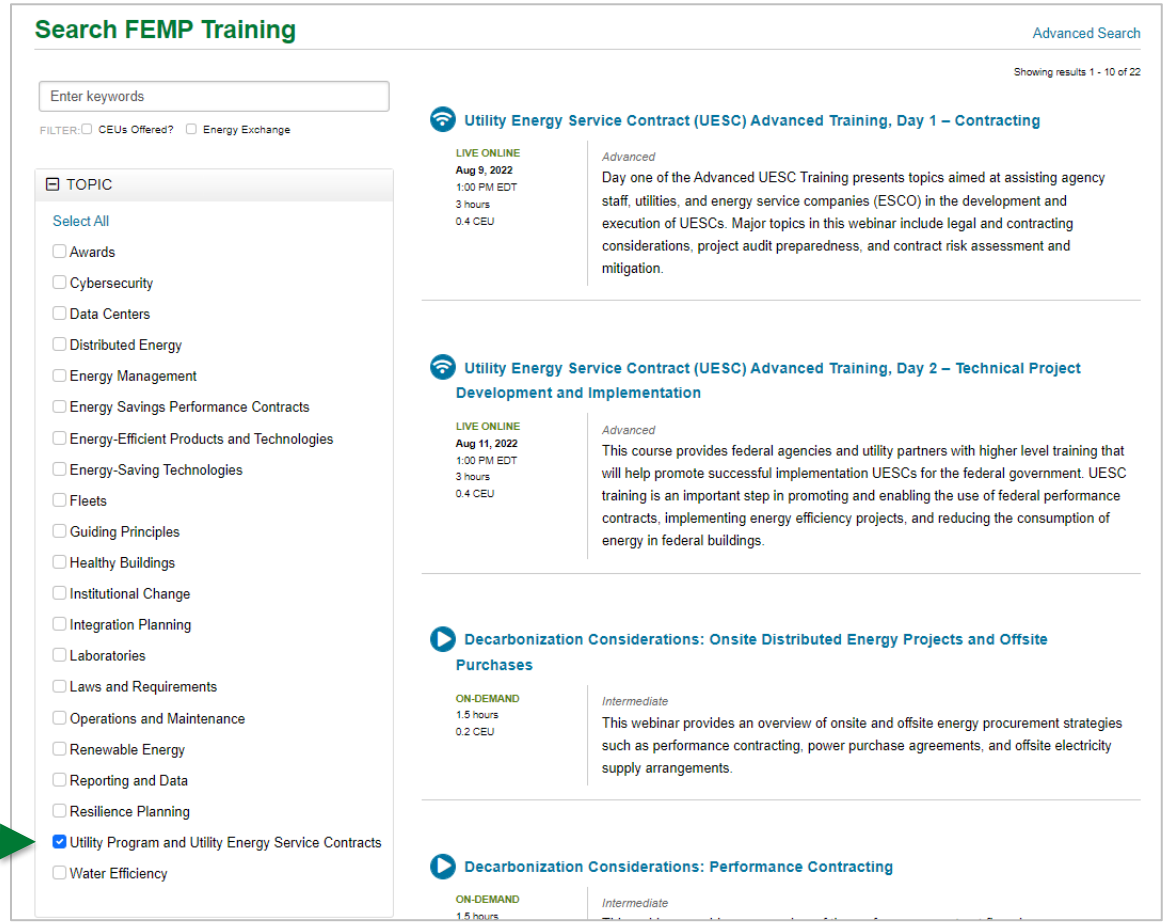
UESC Webinars and On-Demand Training

Live and on-demand webinars can be accessed through the FEMP Training Catalog

- Courses are hosted by the Whole Building Design Guide website
- Continuing Education Units (CEUs) available
- Topics include:
  - 7-part UESC Basics On-Demand Webinar Series
  - Advanced topics such as performance assurance, financing, utility rate analysis, decarbonization considerations, and more!

Filter courses by Utility Program and UESCs

Click Here to View the FEMP Training Catalog



Energy Exchange 2022

Save the Date!

October 25-27, 2022 | Cincinnati, OH

- Theme: Advancing Federal Infrastructure through Innovation
- Sessions on UESCs and other federal energy programs
- Includes Pre-Conference UESC Workshop on October 24
- For more information, go to: energy-exchange.com

Federal Utility Partnership Working Group (FUPWG)

Save the Date!

May 3-4, 2022 | Washington D.C. area

- Led by FEMP to cultivate lasting partnerships between federal agencies and utilities for improved energy and water management.
- Seminars typically held once or twice a year
- Includes training and sessions led by industry experts
- Knowledge sharing around new technologies, best practices, and approaches to achieving energy goals

Visit the FEMP Website to Sign Up for Updates

Federal-Utility Collaboration

Presentations from Past Seminars

Taking the First Step

Talk to the FEMP Federal Project Executive (FPE) in your region for assistance.

energy.gov/eere/femp/energy-savings-performance-contract-federal-project-executives-0

Northeast Region

Tom Hattery
Northeast Region
202-256-5986
thomas.hattery@ee.doe.gov

Southeast Region

Doug Culbreth
Southeast Region
919-870-0051
culbrethcd@ornl.gov

Western Region

Scott Wolf
Western Region
360-866-9163
wolfsc@ornl.gov

IACET-Certified Continuing Education Units (CEU)

To Receive IACET-Certified CEUs:

- **Attend the training in full–no exceptions**
- **Within six weeks of the training (before September 20!):**
  - Complete the assessment (a minimum score of 80% is required)
  - Complete an evaluation of the training

Access the UESC Training Assessment and Evaluation

Day 1 – https://www.wbdg.org/continuing-education/femp-courses/femplw08092022

Day 2 - https://www.wbdg.org/continuing-education/femp-courses/femplw08112022

For logistical questions related to the webinar or evaluation, email Elena Meehan at elena.meehan@ee.doe.gov.

Thank You!

FEMP
Federal Energy Management Program

NREL
NATIONAL RENEWABLE ENERGY LABORATORY