

Exhibit A SCOPE OF WORK

PROJECT AND TASK LIST

| Project & Task #s | CPR | Project & Task Names |
|-----------------------|-----|--|
| Administration | N/A | Program Administration |
| Task A.1 | | Kick-off Meeting |
| Task A.2 | | CPR Meetings |
| Task A.3 | | Final Meeting |
| Task A.4 | | Monthly Progress Reports |
| Task A.5 | | Test Plans, Technical Reports and Interim Deliverables |
| Task A.6 | | Final Report |
| Task A.6.1 | | Final Report Outline |
| Task A.6.2 | | Final Report |
| Task A.7 | | Identify and Obtain Matching Funds |
| Task A.8 | | Identify and Obtain Required Permits |
| Task A.9 | | Electronic File Format |
| Task A.10 | | Establish the PAC |
| Task A.11 | | Conduct PAC Meetings |
| Project 1 | | Understanding the Untapped Markets |
| Task 1.1 | | Develop Baseline Understanding of the MTLC Market |
| Task 1.2 | | Gather Stakeholder Perspectives on the MTLC Market |
| Task 1.3 | | Use Existing Data to Characterize the MTLC Market (Data Mining) |
| Task 1.4 | | Collect New Data to Characterize the MTLC Market (Primary Data Collection) |
| Task 1.5 | | Develop Scoping Plan for Monitoring |
| Task 1.6 | | Understand Segmentation of the MTLC Market |
| Task 1.7 | | Select Buildings for Monitoring |
| Task 1.8 | | Design and Install Monitoring Equipment |
| Task 1.9 | | Integrate and Analyze Monitoring Data |
| Task 1.10 | | Develop Single Integrated Dataset to Characterize the MTLC Market |
| Task 1.11 | X | Analyze Project Results, Synthesize Learning and Refine Perspective |
| Project 2 | | MARKET DRIVEN TECHNOLOGY DEVELOPMENT – BUILDING- & SITE-LEVEL SOLUTIONS |

| Project & Task #s | CPR | Project & Task Names |
|------------------------------|------------|---|
| Task 2.1 | | Identify Existing and Emerging Building Envelope and Exterior Lighting Technologies for MTLC Applications |
| Task 2.2 | | Evaluate Performance Improvements, Energy Savings, Environmental Impacts, and Price to Stakeholders of Existing and Emerging Building Envelope and Exterior Lighting Technologies |
| Task 2.3 | | Identify Potential Product Improvement Opportunities and Work in Collaboration with Manufacturers on Building Envelope and Exterior Lighting Technologies |
| Task 2.4 | | Experimental Design, Technology Installation and Instrumentation for Evaporative Cooling and Load Management Technologies |
| Task 2.5 | | Collect, Analyze and Archive Data on Retrofit RTU Load Management Technology |
| Task 2.6 | | Collect, Analyze and Archive Evaporative Cooling Data |
| Task 2.7 | | Produce Production Readiness Plan |
| Task 2.8 | X | Develop, Conduct and Synthesize Market Research Study |
| Project 3 | | MARKET DRIVEN TECHNOLOGY DEVELOPMENT – TENANT-LEVEL SOLUTIONS |
| Task 3.1 | | Identify Existing and Emerging Interior Lighting Technologies for MTLC Retrofit Applications |
| Task 3.2 | | Evaluate Interior Lighting Performance Improvements, Energy Savings, and Price to Stakeholders |
| Task 3.3 | | Identify Potential Product Improvement Opportunities |
| Task 3.4 | | Identify Existing and Emerging Energy Efficient Building Envelope Products for MTLC Applications |
| Task 3.5 | | Evaluate Building Envelope Performance Improvements, Energy Savings, Price to Stakeholders |
| Task 3.6 | | Identify Potential Building Envelope Product Improvement Opportunities |
| Task 3.7 | | Identify Existing and Emerging Lighting Control Technologies for MTLC Applications |
| Task 3.8 | | Evaluate Lighting Control Performance Improvements, Energy Savings, Environmental Impacts, Price to Stakeholders |
| Task 3.9 | | Identify Potential Improvement Opportunities |
| Task 3.10 | | Investigate HVAC Equipment Capacity Analysis Tools |
| Task 3.11 | | Develop and Test a Tool for Assessing HVAC Downsizing Potential |

| Project & Task #s | CPR | Project & Task Names |
|------------------------------|------------|---|
| Task 3.12 | | Performance Testing of Electronic Expansion Valve |
| Task 3.13 | X | Conduct and Synthesize Market Research Study |
| Project 4 | | TURN-KEY ENERGY EFFICIENCY RETROFIT SOLUTIONS |
| Task 4.1 | | Review existing Utility Efficiency Audit Programs |
| Task 4.2 | | Develop Approach for First-cut Efficiency Auditing and Decision Support in the MTLC Market |
| Task 4.3 | | Compile and Review Results from Projects 1, 2 and 3 |
| Task 4.4 | | Build Scenario-based Value Chain and Value-proposition Model |
| Task 4.5 | | Determine Value-proposition by Stakeholder Group for Individual Technology Solutions |
| Task 4.6 | | Develop Turn-key Retrofit Packages of Integrated Solutions for Each MTLC Market Sub-Segment |
| Task 4.7 | | Determine Value-proposition by Stakeholder Group for Tailored Package of Solutions |
| Task 4.8 | | Laboratory Testing and Technology Refinement of Integrated Technology Solutions |
| Task 4.9 | X | Synthesis of Results |
| Project 5 | | FULL SCALE FIELD RESEARCH OF WHOLE-BUILDING RETROFITS |
| Task 5.1 | | Test Site Identification |
| Task 5.2 | | Retrofit Solution Design and Specification |
| Task 5.3 | | Retrofit Package Installation and Commissioning |
| Task 5.4 | | Retrofit Packages Performance Monitoring |
| Task 5.5 | | Data Analysis and Reporting |

KEY NAME LIST

| Task # | Key Personnel | Key Subcontractor(s) | Key Partner(s) |
|---------------|------------------------------------|-----------------------------|--|
| A | Mark Modera | | PG&E, SCE, Sempra |
| 1 | Michael Siminovitch Mark Modera | SCE | PG&E, SCE, Sempra |
| 2 | Mark Modera | | Thermal Flow, REGEN, Evaporcool, Beutler |
| 3 | Michael Siminovitch Mark Modera | SCE | 3M, Microstaq, PGE, SCE, Sempra |
| 4 | Michael Siminovitch | | PG&E, SCE, Sempra, |

| Task # | Key Personnel | Key Subcontractor(s) | Key Partner(s) |
|--------|------------------------------------|----------------------|--|
| | Mark Modera | | Bank of America |
| 5 | Michael Siminovitch Mark Modera | | PG&E, SCE, Sempra, Target, Bank of America |

GLOSSARY

Specific terms and acronyms used throughout this work statement are defined as follows:

| Acronym | Definition |
|-------------------|---|
| ACCA | Air-Conditioning Contractors of America |
| ASHRAE | American Society of Heating, Refrigerating and Air-Conditioning Engineers |
| BERG | Building Energy Research Grant |
| CalCEF | California Clean Energy Fund |
| CBECS | Commercial Buildings Energy Consumption Survey |
| CCT | Correlated Color Temperature |
| CEDR | Cost Effective Demand Response |
| CEUS | California Commercial End-Use Survey |
| CLTC | California Lighting Technology Center |
| CO _{2e} | Carbon Dioxide Equivalents |
| CPR | Critical Project Review |
| CPUC | California Public Utilities Commission |
| CRI | Color Rendering Index |
| DALI | Digital Addressable Lighting Interface |
| DR | Demand Response |
| EE&DSM | Energy Efficiency & Demand-Side Management |
| EEC | Energy Efficiency Center |
| Energy Commission | California Energy Commission |
| ET | Emerging Technologies |
| GSM | UC Davis Graduate School of Management |
| HID | High Intensity Discharge (lamps, ballasts) |
| HPS | High Pressure Sodium |
| HVAC | Heating, Ventilation and Air Conditioning |
| ICSC | International Council of Shopping Center |
| IPMVP | International Performance Measurement & Verification Protocol |
| IOU | Investor Owned Utility |
| kW | Kilo Watt |

| Acronym | Definition |
|----------------|--|
| kWh | Kilo Watt Hour |
| LBNL | Lawrence Berkeley National Laboratory |
| LCF | Lighting California's Future |
| LED | Light Emitting Diode |
| LEED | Leadership in Energy and Environmental Design |
| MH | Metal Halide |
| MS | Microsoft Corp. |
| MTLC | Multi-Tenant Light Commercial |
| MUD | Municipal Utility Districts |
| M&V | Measurement and Verification Protocols |
| NEMA | National Electric Manufacturers Association |
| PAC | Program Advisory Committee |
| PDF | Portable Document Format |
| PG&E | Pacific Gas and Electric Company |
| PI | Principal Investigator |
| PIER | Public Interest Energy Research |
| PLS | Personal Lighting System |
| RD&D | Research Development & Demonstration |
| RTTC | Refrigeration and Thermal Test Center |
| RTTP | Real Time Transport Protocol |
| RTU | Packaged Rooftop Unit---Cooling equipment |
| SCE | Southern California Edison |
| SDG&E | San Diego Gas & Electric |
| TDD | Tubular Daylighting Device |
| UCC.1 | Uniform Commercial Code (Financing Statement) |
| US DOE, EIA | U.S. Department of Energy, Energy Information Administration |
| VSP | Verified Service Provider |
| WCEC | Western Cooling Efficiency Center at UC Davis |

PROBLEM STATEMENT

To meet California's goals for increasing energy efficiency and reducing peak demand and green house gas emissions, it is essential that California's efforts include the retrofit of existing buildings, most of which have outdated technologies, and represent the most promising opportunity to realize California's green house gas reduction and energy efficiency goals.

California needs wide-scale deployment of whole-building energy efficiency retrofits in every sector of the economy. Multi-Tenant Light Commercial (MTLC) buildings pose a particular challenge, because the businesses and technical needs in this market sector are diverse and complex. MTLC buildings include office parks, strip malls, and mixed-use buildings that typically range between 100 and 500 kilo watt (kW) demand usage. Typically there is mixed usage with the first floor being used for retail and the second floor for offices. Because demand falls below 500 kW, these facilities normally do not have assigned utility account managers and are not included in Mass Market programs because their usage is above residential and multi-tenant sectors. The MTLC market is characterized by multiple tenants, a wide array of lease agreements, distributed costs, and multiple decision-makers. The energy profiles of MTLC buildings is difficult to characterize and challenging to influence. Success for energy efficiency requires sophisticated research about the technical and business needs in this market followed by development of technology innovation and delivery mechanisms that are tailored to meet those needs.

GOAL OF THE AGREEMENT

The goal of this agreement is to develop technological and market-based approaches that will increase deployment of energy-efficient technologies and reduce peak demand for existing MTLC buildings in California. It includes developing cost-effective, commercially viable, whole-building, integrated technology and financing solutions that address building envelop, lighting (interior and exterior), and heating ventilation air conditioning (HVAC) including integrated controls.

OBJECTIVES OF THE AGREEMENT

The objectives of this agreement are to:

- Identify and/or develop products that reduce energy consumption for MTLC exterior lighting applications by 20-50%.
- Identify/develop products that reduce maintenance costs for exterior lighting by 20%.
- Develop retrofit recommendations for interior and exterior lighting, building envelopes, and lighting controls that will reduce energy consumption and demand in MTLC buildings by 25-45%.
- Expand the range of high efficiency and intelligently controlled lighting solutions available to California utility programs.
- Decrease cooling energy consumption and peak electricity demand in existing MTLC facilities by 30-50%.
- Increase the cooling capacity of Packaged Rooftop Units (RTU)---Cooling equipment, in multi-RTU facilities by 20%.
- Reduce the connected load of Heating, Ventilation, and Air Conditioning (HVAC) equipment in existing MTLC buildings to match the reductions in cooling loads from the envelope, lighting and controls retrofits and capacity improvements provided by RTU retrofits.
- Assess the importance of each technology's attributes from the perspective of the market stakeholders based on customer response.

- Assess the importance of non-product attributes that affect marketability of energy efficiency measures (such as financing options, technology bundling or direct install programs).
- Provide manufacturers with an assessment of customers' interests, needs and motivations as related to particular technologies.
- Stimulate manufacturer partners to improve product selection tailored to the needs of MTLC facilities.
- Provide market intelligence that has an impact on the design and marketing of energy-efficient building technologies.
- Develop integrated technology packages that address lighting, envelope, HVAC and controls suitable for cost-effective retrofits for the MTLC market.
- Develop utility programs to help bring the integrated technology retrofit packages to the market.
- Develop audit and analysis tools that will facilitate the selection and implementation of integrated technology solutions for different segments of the MTLC market in California.
- Demonstrate the integrated retrofit packages in three buildings, one in each of the Key Partner's territories
- Validate performance of the recommended turn-key retrofit packages in operation.
- Validate the expected energy savings from turn-key retrofit packages in MTLC facilities.
- Validate the expected chain of cost for all stakeholders in the market.
- Determine where incentives work best to promote the turn-key efficiency retrofit projects (upstream, mid-stream or downstream).
- Improve penetration of emerging energy efficiency technologies.
- Identify and overcome the main barriers in deploying energy efficiency retrofits in the MTLC market.
- Demonstrate that energy consumption in MTLC can be cost effectively reduced by at least 30% through deployment of energy-efficient retrofit packages. The respective energy saving contributions of the proposed solutions are approximately 15% from exterior lighting, 40% from building envelope and interior lighting, and 45% from cooling and refrigeration.
- Provide recommendations for market-ready packages of energy efficiency retrofit products that can be inserted into energy efficiency utility programs upon completion of the proposed program.

ADMINISTRATION

MEETINGS

Task A.1 Attend Kick-off Meeting

The goal of this task is to establish the lines of communication and procedures for implementing this Agreement.

The Contractor shall:

- Attend a “kick-off” meeting with the Commission Contract Manager, the Contracts Officer, and a representative of the Accounting Office. The Contractor shall bring their Project Manager, Contracts Administrator, Accounting Officer, and others designated by the Commission Contract Manager to this meeting. The administrative and technical aspects of this Agreement will be discussed at the meeting. Prior to the kick-off meeting, the Commission Contract Manager will provide an agenda to all potential meeting participants. The administrative portion of the meeting shall include, but not be limited to, the following:
 - Terms and conditions of the Agreement
 - CPRs (Task A.2)
 - Match fund documentation (Task A.7)
 - Permit documentation (Task A.8)

The technical portion of the meeting shall include, but not be limited to, the following:

- The Commission Contract Manager’s expectations for accomplishing tasks described in the Scope of Work;
- An updated Schedule of Deliverables
- Progress Reports (Task A.4)
- Technical Deliverables (Task A.5)
- Final Report (Task A.6)
- Establish the PAC (Task A.10)
- PAC Meetings (Task A.11)

The Commission Contract Manager shall:

- Designate the date and location of this meeting.

Contractor Deliverables:

- An Updated Schedule of Deliverables
- An Updated List of Match Funds
- An Updated List of Permits
- Schedule for Recruiting PAC Members

Commission Contract Manager Deliverables:

- Final Report Instructions

Task A.2 CPR Meetings

The goal of this task is to determine if the project should continue to receive Energy Commission funding to complete this Agreement and if it should, are there any modifications that need to be made to the tasks, deliverables, schedule or budget.

CPRs provide the opportunity for frank discussions between the Energy Commission and the Contractor. CPRs generally take place at key, predetermined points in the Agreement, as determined by the Commission Contract Manager and as shown in the Technical Task List above and in the Schedule of Deliverables. However, the Commission Contract Manager may schedule additional CPRs as necessary, and any additional costs will be borne by the Contractor.

Participants include the Commission Contract Manager and the Contractor, and may include the Commission Contracts Officer, the PIER Program Team Lead, other Energy Commission staff and Management as well as other individuals selected by the Commission Contract Manager to provide support to the Energy Commission.

The Commission Contract Manager shall:

- Determine the location, date and time of each CPR meeting with the Contractor. These meetings generally take place at the Energy Commission, but they may take place at another location.
- Send the Contractor the agenda and a list of expected participants in advance of each CPR. If applicable, the agenda shall include a discussion on both match funding and permits.
- Conduct and make a record of each CPR meeting. One of the outcomes of this meeting will be a schedule for providing the written determination described below.
- Determine whether to continue the project, and if continuing, whether or not to modify the tasks, schedule, deliverables and budget for the remainder of the Agreement, including not proceeding with one or more tasks. If the Commission Contract Manager concludes that satisfactory progress is not being made, this conclusion will be referred to the Energy Commission's Research, Development and Demonstration Policy Committee for its concurrence.
- Provide the Contractor with a written determination in accordance with the schedule. The written response may include a requirement for the Contractor to revise one or more deliverable(s) that were included in the CPR.

The Contractor shall:

- Prepare a CPR Report for each CPR that discusses the progress of the Agreement toward achieving its goals and objectives. This report shall include recommendations and conclusions regarding continued work of the projects. This report shall be submitted along with any other deliverables identified in this Scope of Work. Submit these documents to the Commission Contract Manager and any other designated reviewers at least 15 working days in advance of each CPR meeting.
- Present the required information at each CPR meeting and participate in a discussion about the Agreement.

Contractor Deliverables:

- CPR Report(s)
- CPR deliverables identified in the Scope of Work

Commission Contract Manager Deliverables:

- Agenda and a List of Expected Participants

- Schedule for Written Determination
- Written Determination

Task A.3 Final Meeting

The goal of this task is to closeout this Agreement.

The Contractor shall:

- Meet with the Energy Commission to present the findings, conclusions, and recommendations. The final meeting must be completed during the closeout of this Agreement.

This meeting will be attended by, at a minimum, the Contractor, the Commission Contracts Officer, and the Commission Contract Manager. The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be two separate meetings at the discretion of the Commission Contract Manager.

The technical portion of the meeting shall present findings, conclusions, and recommended next steps (if any) for the Agreement. The Commission Contract Manager will determine the appropriate meeting participants.

The administrative portion of the meeting shall be a discussion with the Commission Contract Manager and the Contracts Officer about the following Agreement closeout items:

- What to do with any state-owned equipment (Options)
- Need to file UCC.1 form re: Energy Commission's interest in patented technology
- Energy Commission's request for specific "generated" data (not already provided in Agreement deliverables)
- Need to document Contractor's disclosure of "subject inventions" developed under the Agreement
- "Surviving" Agreement provisions, such as repayment provisions and confidential deliverables
- Final invoicing and release of retention
- Prepare a schedule for completing the closeout activities for this Agreement.

Deliverables:

- Written documentation of meeting agreements and all pertinent information
- Schedule for completing closeout activities

REPORTING

See Exhibit D, Reports/Deliverables/Records.

Task A.4 Quarterly Progress Reports

The goal of this task is to periodically verify that satisfactory and continued progress is made towards achieving the research objectives of this Agreement.

The Contractor shall:

- Prepare progress reports which summarize all Agreement activities conducted by the Contractor for the reporting period, including an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. Each progress report is due to the Commission Contract Manager within 10 working days after the end of the reporting period. Attachment A-2, Progress Report Format, provides the recommended specifications.

Deliverables:

- Quarterly Progress Reports

Task A.5 Test Plans, Technical Reports and Interim Deliverables

The goal of this task is to set forth the general requirements for submitting test plans, technical reports and other interim deliverables, unless described differently in the Technical Tasks. When creating these deliverables, the Contractor shall use and follow, unless otherwise instructed in writing by the Commission Contract Manager, the latest version of the PIER Style Manual published on the Energy Commission's web site:

<http://www.energy.ca.gov/contracts/pier/contractors/index.html>

The Contractor shall:

- Unless otherwise directed in this Scope of Work, submit a draft of each deliverable listed in the Technical Tasks to the Commission Contract Manager for review and comment in accordance with the approved Schedule of Deliverables. The Commission Contract Manager will provide written comments back to the Contractor on the draft deliverable within 10 working days of receipt. Once agreement has been reached on the draft, the Contractor shall submit the final deliverable to the Commission Contract Manager. The Commission Contract Manager shall provide written approval of the final deliverable within 5 working days of receipt. Key elements from this deliverable shall be included in the Final Report for this project.

Task A.6 Final Report

The goal of this task is to prepare a comprehensive written Final Report that describes the original purpose, approach, results and conclusions of the work done under this Agreement. The Commission Contract Manager will review and approve the Final Report. The Final Report must be completed on or before the termination date of the Agreement. When creating these deliverables, the Contractor shall use and follow, unless otherwise instructed in writing by the Commission Contract Manager, the latest version of the PIER Style Manual published on the Energy Commission's web site:

<http://www.energy.ca.gov/contracts/pier/contractors/index.html>

The Final Report shall be a public document. If the Contractor has obtained confidential status from the Energy Commission and will be preparing a confidential version of the Final Report as well, the Contractor shall perform the following subtasks for both the public and confidential versions of the Final Report.

Task A.6.1 Final Report Outline

The Contractor shall:

- Prepare a draft outline of the Final Report.
- Submit the draft outline of Final Report to the Commission Contract Manager for review and approval. The Commission Contract Manager will provide written comments back to the Contractor on the draft outline within 10 working days of receipt. Once agreement has been reached on the draft, the Contractor shall submit the final outline to the Commission Contract Manager. The Commission Contract Manager shall provide written approval of the final outline within 5 working days of receipt.

Deliverables:

- Draft Outline of the Final Report
- Final Outline of the Final Report

Task A.6.2 Final Report

The Contractor shall:

- Prepare the draft Final Report for this Agreement in accordance with the approved outline.
- Submit the draft Final Report to the Commission Contract Manager for review and comment. The Commission Contract Manager will provide written comments within 10 working days of receipt.
Once agreement on the draft Final Report has been reached, the Commission Contract Manager shall forward the electronic version of this report for Energy Commission internal approval. Once the approval is given, the Commission Contract Manager shall provide written approval to the Contractor within 5 working days.
- Submit one bound copy of the Final Report with the final invoice.

Deliverables:

- Draft Final Report
- Final Report

MATCH FUNDS, PERMITS, AND ELECTRONIC FILE FORMAT

Task A.7 Identify and Obtain Matching Funds

The goal of this task is to ensure that the match funds planned for this Agreement are obtained for and applied to this Agreement during the term of this Agreement.

The costs to obtain and document match fund commitments are not reimbursable through this Agreement. While the PIER budget for this task will be zero dollars, the Contractor may utilize match funds for this task. Match funds shall be spent concurrently or in advance of PIER funds during the term of this Agreement. Match funds must be identified in writing, and the associated commitments obtained before the Contractor can incur any costs for which the Contractor will request reimbursement.

The Contractor shall:

- Prepare a letter documenting the match funding committed to this Agreement and submit it to the Commission Contract Manager at least 2 working days prior to the kick-off meeting:
 1. If no match funds were part of the proposal that led to the Energy Commission awarding this Agreement and none have been identified at the time this Agreement starts, then state such in the letter.
 2. If match funds were a part of the proposal that led to the Energy Commission awarding this Agreement, then provide in the letter:
 - A list of the match funds that identifies the:
 - Amount of each cash match fund, its source, including a contact name, address and telephone number and the task(s) to which the match funds will be applied.
 - Amount of each in-kind contribution, a description, documented market or book value, and its source, including a contact name, address and telephone number and the task(s) to which the match funds will be applied. If the in-kind contribution is equipment or other tangible or real property, the Contractor shall identify its owner and provide a contact name, address and telephone number, and the address where the property is located.
 - A copy of the letter of commitment from an authorized representative of each source of cash match funding or in-kind contributions that these funds or contributions have been secured.
- Discuss match funds and the implications to the Agreement if they are significantly reduced or not obtained as committed, at the kick-off meeting. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.
- Provide the appropriate information to the Commission Contract Manager if during the course of the Agreement additional match funds are received.
- Notify the Commission Contract Manager within 10 working days if during the course of the Agreement existing match funds are reduced. Reduction in match funds may trigger an additional CPR.

Deliverables:

- A letter regarding Match Funds or stating that no Match Funds are provided
- Letter(s) for New Match Funds
- A copy of each Match Fund commitment letter
- Letter that Match Funds were Reduced (if applicable)

Task A.8 Identify and Obtain Required Permits

The goal of this task is to obtain all permits required for work completed under this Agreement in advance of the date they are needed to keep the Agreement schedule on track.

Permit costs and the expenses associated with obtaining permits are reimbursable under this Agreement. Permits must be identified in writing before the Contractor can incur any costs related to the use of the permit(s) for which the Contractor will request reimbursement.

The Contractor shall:

- Prepare a letter documenting the permits required to conduct this Agreement and submit it to the Commission Contract Manager at least 2 working days prior to the kick-off meeting:
 1. If there are no permits required at the start of this Agreement, then state such in the letter.
 2. If it is known at the beginning of the Agreement that permits will be required during the course of the Agreement, provide in the letter:
 - A list of the permits that identifies the:
 - Type of permit
 - Name, address and telephone number of the permitting jurisdictions or lead agencies
 - Schedule the Contractor will follow in applying for and obtaining these permits.
- The list of permits and the schedule for obtaining them will be discussed at the kick-off meeting, and a timetable for submitting the updated list, schedule and the copies of the permits will be developed. The implications to the Agreement if the permits are not obtained in a timely fashion or are denied will also be discussed. If applicable, permits will be included as a line item in the progress reports and will be a topic at CPR meetings.
- If during the course of the Agreement additional permits become necessary, then provide the appropriate information on each permit and an updated schedule to the Commission Contract Manager.
- As permits are obtained, send a copy of each approved permit to the Commission Contract Manager.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the Commission Contract Manager within 5 working days. Either of these events may trigger an additional CPR.

Deliverables:

- A letter documenting the Permits or stating that no Permits are required
- Updated list of Permits as they change during the Term of the Agreement
- Updated schedule for acquiring Permits as it changes during the Term of the Agreement
- A copy of each approved Permit

Task A.9 Electronic File Format

The goal of this task is to unify the formats of electronic data and documents provided to the Energy Commission as contract deliverables. Another goal is to establish the computer platforms, operating systems and software that will be required to review and approve all software deliverables.

The Contractor shall:

- Deliver documents to the Commission Contract Manager in the following formats:
 - Data sets shall be in Microsoft (MS) Access or MS Excel file format.
 - PC-based text documents shall be in MS Word file format.
 - Documents intended for public distribution shall be in PDF file format, with the native file format provided as well.
 - Project management documents shall be in MS Project file format.
- Request exemptions to the electronic file format in writing at least 90 days before the deliverable is submitted.

Deliverables:

- A letter requesting exemption from the Electronic File Format (if applicable)

PAC

Task A.10 Establish the PAC

The goal of this task is to create an advisory committee for this Agreement.

The PAC will be composed of diverse professionals. The number can vary depending on potential interest and time availability. The Contractor's Project Manager and the Commission Contract Manager shall act as co-chairs of the PAC. The exact composition of the PAC may change as the need warrants. PAC members serve at the discretion of the Commission Contract Manager.

The PAC may be composed of qualified professionals spanning the following types of disciplines:

- Researchers knowledgeable about the project subject matter
- Members of the trades who will apply the results of the project (e.g., designers, engineers, architects, contractors, and trade representatives)
- Public Interest Market Transformation Implementers
- Product Developers relevant to project subject matter
- U.S. Department of Energy Research Manager
- Public Interest Environmental Groups
- Utility Representatives
- Members of the relevant technical society committees

The purpose of the PAC is to:

- Provide guidance in research direction:
 - selection of experimental homes

- relevant efficiency measures
- linkages between the agreement work and other past, present or future research (both public and private sectors) they are aware of in a particular area.
- Review deliverables. Provide specific suggestions and recommendations for needed adjustments, refinements, or enhancement of the deliverables.
- Evaluate tangible benefits to California of this research and provide recommendations, as needed, to enhance tangible benefits.
- Provide recommendations regarding information dissemination, market pathways or commercialization strategies relevant to the research products.

The Contractor shall:

- Prepare a draft list of potential PAC members that includes name, company, physical and electronic address, and phone number and submit it to the Commission Contract Manager at least 2 working days prior to the kick-off meeting. This list will be discussed at the kick-off meeting and a schedule for recruiting members and holding the first PAC meeting will be developed.
- Recruit PAC members and ensure that each individual understands the member obligations described above, as well as the meeting schedule outlined in Task A.11.
- Prepare the final list of PAC members.
- Submit letters of acceptance or other comparable documentation of commitment for each PAC member.

Deliverables:

- Draft List of PAC Members
- Final List of PAC Members
- Letters of acceptance, or other comparable documentation of commitment for each PAC Member

Task A.11 Conduct PAC Meetings

The goal of this task is for the PAC to provide strategic guidance to this project by participating in regular meetings or teleconferences.

The Contractor shall:

- Discuss the PAC meeting schedule at the kick-off meeting. The Contractor shall anticipate having regular meetings via the internet and few or perhaps no face to face meetings. The number of face-to-face meetings and teleconferences and the location of PAC meetings shall be determined in consultation with the Commission Contract Manager. This draft schedule shall be presented to the PAC members during recruiting and finalized at the first PAC meeting.
- Organize and lead PAC meetings in accordance with the schedule. Changes to the schedule must be pre-approved in writing by the Commission Contract Manager.
- Prepare PAC meeting agenda(s) with back-up materials for agenda items.

- Prepare PAC meeting summaries, including recommended resolution of major PAC issues.

Deliverables:

- Draft PAC Meeting Schedule
- Final PAC Meeting Schedule
- PAC Meeting Agenda(s) with Back-up Materials for Agenda Items
- PAC meeting powerpoints and other presentations
- Written PAC meeting summaries, including recommended resolutions of major PAC issues

TECHNICAL TASKS

The Contractor shall prepare all deliverables in accordance with the requirements in Task A.5. Deliverables not requiring a draft version are indicated by marking “(no draft)” after the deliverable name.

Project 1: UNDERSTANDING THE UNTAPPED MARKETS

MARKET CHARACTERIZATION

Task List

The project’s work scope involves the following technical tasks:

| Project & Tasks | CPR | Project & Task Names |
|------------------|-----|--|
| Project 1 | | UNDERSTANDING THE UNTAPPED MARKETS |
| Task 1.1 | | Develop Baseline Understanding of the MTLC Market |
| Task 1.2 | | Gather Stakeholder Perspectives on the MTLC Market |
| Task 1.3 | | Use Existing Data to Characterize the MTLC Market (Data Mining) |
| Task 1.4 | | Collect New Data to Characterize the MTLC Market (Primary Data Collection) |
| Task 1.5 | | Develop Scoping Plan for Monitoring |
| Task 1.6 | | Understand Segmentation of the MTLC Market |
| Task 1.7 | | Select Buildings for Monitoring |
| Task 1.8 | | Design and Install Monitoring Equipment |
| Task 1.9 | | Integrate and Analyze Monitoring Data |
| Task 1.10 | | Develop Single Integrated Dataset to Characterize the MTLC Market |
| Task 1.11 | X | Analyze Project Results, Synthesize Learning and Refine Perspective |

Task 1.1 Develop Baseline Understanding of the MTLC Market

The goal of this task is to identify the market stakeholders in the MTLC market, as well as the technical and market attributes that influence their needs, resources and decisions. The team will produce a network map that will show the relationships that connect these diverse market stakeholders.

The Contractor shall:

- Develop a list of stakeholder groups in the MTLC market to include but not be limited to:
 - end users, tenants, building owners, manufacturers, distributors, installers, financiers, State of CA and utilities.
- Contact particular individuals to represent each stakeholder group.
- Acquire commitment for stakeholder participation in the project.
- Develop a prioritized list of attributes and metrics to characterize the MTLC market. These may include, but are not limited to:
 - Metrics: square footage, energy consumed, age, energy price, rental rate, real estate value.
 - Attributes: equipment type, building management life cycle, lease type, utility payment agreement, business type, current state of knowledge among stakeholders.
- Seek close collaboration from Key Partners to guide and review the results of this task.
- Prepare a MTLC Market Baseline Report containing, but not limited to the baseline understanding of the MTLC market, contact list of key stakeholder groups, and prioritized attributes to characterize the MTLC market.

Deliverables:

- MTLC Market Baseline Report (no draft)

Task 1.2 Gather Stakeholder Perspectives on the MTLC Market

The goal of this task is to gather input from the stakeholders to define the metrics and attributes of the MTLC market and identify the barriers to prospective retrofit solutions.

The Contractor shall:

- Gather stakeholder input on how to characterize the MTLC market by:
 - Conducting outreach to specific stakeholders to generate additional metrics and attributes, and gauge stakeholder perspectives on the importance of various metrics and attributes in the decision making process.
 - Determining the extent to which the stakeholders' perspective about what is important differs from that of the technologists who will design energy efficiency solutions.
- Identify primary market impediments to energy efficiency measures by:
 - Designing multiple efficiency retrofit scenarios.
 - Gathering stakeholder response to these scenarios, including identification of likely barriers to success and potential failure modes.

- Prepare a Stakeholder Perspective Report to include, but not be limited to, stakeholder input, augmented list of attributes, key risk factors, refined prioritization, market barriers, refined metrics that characterize the MTLC market.

Deliverables:

- MTLC Market Stakeholder Perspective Report (no draft)

Task 1.3 Use Existing Data to Characterize the MTLC Market (Data Mining)

The goal of this task is to gather and consolidate existing data held by different stakeholders to create a single comprehensive database that can assist in defining the MTLC market. The energy usage and market intelligence for a sample of these assets will be compiled and analyzed to better define the technical and market opportunities and barriers associated with potential integrated energy efficiency solutions. The collection and analysis of existing or secondary data in this task will come before new or primary data collection to improve the quality of survey designs and sector “expert” interviews.

The Contractor shall:

- Identify sources for existing data (primary sources include the three Investor Owned Utilities (IOU), Bank of America, and Project Advisory Committee (PAC) members). The IOUs will share data that is not confidential by eliminating customer related information. Additional sources will be identified based on the refined lists of characterizing attributes and metrics.
- Determine extent, quality, availability and format of existing data.
- Develop a design method for analyzing data.
- Develop a design method for existing or secondary data compilation by:
 - Developing a database shell with defined analysis tools.
 - Developing a standard format, standard values, and complete list of variables to collect.
- Conduct secondary data collection and compilation.
- Analyze secondary data (e.g., regression, nearest neighbor, cluster analysis, factor analysis).
- Compile the list of variables to be collected via new or primary research.
- Prepare a Characterization Report on MTLC Market based on existing data and including, but not limited to, data held by different stakeholders to create a single comprehensive database that can assist in defining the MTLC market.

Deliverables:

- MTLC Market Characterization Report (no draft)

Task 1.4 Collect New Data to Characterize the MTLC Market (Primary Data Collection)

The goal of this task is to gather new information directly from stakeholders to fill data gaps for any important attributes that cannot be well assessed through existing data in Task 1.3. This will require the development and implementation of appropriate market research techniques that will help to understand the value market stakeholders place on technologies, delivery mechanisms and financial transactions. This will include, but not be limited to, understanding stakeholder's sensitivity to costs and payback, installation time and process, capital requirements, performance guarantees and contracting, non-energy benefits, incentive alignment, evaluation monitoring and verification.

The Contractor shall:

- Identify sources for primary data to characterize the MTLC market by:
 - Reaching out to points of contact including experts, professionals and users of existing technologies.
- Prioritize or aggregate variables of interest in order to refine research to a manageable scope.
- Develop a design method for primary data collection and analysis.
- Conduct primary data collection.
- Analyze primary data using standard tools and methods.
- Prepare a Market Characterization Report based on new data and including, but not limited to, data collected directly from the stakeholders to fill data gaps for any important attributes that cannot be assessed from existing data in Task 1.3. This may include, but not be limited to, sources of primary data, variables of interest, and methodology for data collection and analysis.

Deliverables:

- MTLC Primary Market Characterization Report (no draft)

SUB-METERING / BUILDING PERFORMANCE MONITORING

Task 1.5 Develop Scoping Plan for Monitoring

The goal of this task is to determine what field measurements are needed to characterize energy system performance in each market sub-segment to inform the other projects in this program, to identify gaps in existing data (based upon Tasks 1.1-1.4) and to consider the needs of other stakeholders in the design of the sub-metering field study. This task will inform how Task 1.8 will be implemented.

The Contractor shall:

- Develop a list of needed data by identifying the key parameters that best define energy use in MTLC building systems, which may affect the success of integrated efficiency retrofits and the retrofit selection/design process.
- Identify the gaps in desired market characterization data.
- Determine how the results of this study might be useful to other stakeholders, and consider the possible needs of those users.

- Specify field measurements required to assess the performance parameters which may include but not be limited to:
 - Circuit loads, light levels, temperatures, occupancy, and HVAC equipment performance.
- Prepare a Scoping Plan Report including, but not limited to performance indicators, data gaps, needs assessment, and a list of required field measurements.

Deliverables:

- Field Measurements Scoping Plan Report (no draft)

Task 1.6 Understand Segmentation of the MTLC Market

The goal of this task is to identify major sub-segments of the MTLC market that can be characterized by particular groups of attributes that affect energy consumption and/or impact the likely success of energy efficiency programs. Market segmentation will determine the size and importance of various types of MTLC buildings and will inform and optimize Task 1.7.

The Contractor shall:

- Define major MTLC market sub-segments based on the dataset and analyzed results from the Market Characterization grouped by sets of attributes that have a significant impact on energy system performance and success of energy efficiency programs.
- Prepare a MTLC Market Segmentation Report including, but not limited to, the major sub-segments of the MTLC market that can be characterized by particular groups of attributes that affect energy consumption and/or impact the likely success of energy efficiency programs.

Deliverables

- MTLC Market Segmentation Report (no draft)

Task 1.7 Select Buildings for Monitoring

The goal of this task is to select building(s) in which to conduct the monitoring. The team, in collaboration with its utility and industry partners, will consider findings from Tasks 1.1 through 1.6 in developing a list of criteria for building selection. The building(s) selected will represent a large sub-segment within MTLC buildings.

The Contractor shall:

- Identify candidate buildings performance monitoring.
- Select buildings that best represent major market segments, defined in Task 1.6.
- Document the criteria used to select buildings.
- Prepare a Building Selection Report including, but not limited to, documenting the buildings selected for further study and monitoring, a list of the selection criteria, list of parameters that will be monitored, analysis of the data.

Deliverables:

- Building Selection Report (no draft)

Task 1.8 Design and Install Monitoring Equipment

The goal of this task is to install customized monitoring equipment in selected buildings, in collaboration with utility and industry partners. The design of the monitoring strategy will be based on Task 1.7 and field conditions of the selected buildings. The targeted data for collection will be used to improve the baseline characterization of the MTLC market.

The Contractor shall:

- Develop a measurement & verification (M&V) plan:
 - The field measurements will capture the key parameters defined in Task 1.5.
 - The M&V plan will be designed to yield statistically significant data that is representative of energy use characteristics for the building being monitored.
 - The M&V plan will be designed so that data can be correlated with knowledge about whole-building energy use for multiple years to yield an accurate characterization of energy system consumption patterns.
 - The monitoring plan will be designed and installed in accordance with industry standard M&V protocols. These standards and protocols may include American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), Guideline 14: Measurement of Energy and Demand Savings, the Greenhouse Gas Protocol for Project Accounting, the California Public Utility Commission's (CPUC), California Energy Efficiency Evaluation Protocols, and the International Performance Measurement and Verification Protocol (IPMVP).
- Install monitoring equipment in each of the buildings selected:
 - Instrumentation and data acquisition strategies will vary based on the type, extent and quality of data needed. Data acquisition may range from simple, standalone data logging to web enabled, real time data monitoring.
- Conduct monitoring, collect data and consolidate information into a standard format for inclusion in the market characterization dataset.
 - Evaluate the data at regular intervals during the testing periods to assure quality and uncover any need for additional data points.
- Collaborate with key partners throughout the task.
- Prepare a Building Monitoring and Measurement Report including, but not limited to, collecting field measurements and designing a Measurement & Verification plan.

Deliverables:

- Building Monitoring and Measurement Report (no draft)

Task 1.9 Integrate and Analyze Monitoring Data

The goal of this task is to utilize an on-line tool to integrate data from the monitoring study into a single database and analyze the results. The results and the analysis tool will allow for sensitivity analysis and extrapolation of the results.

The Contractor shall:

- Consolidate all sub-metering/building performance monitoring data.

- Evaluate the plausible errors arising from the use of a limited specific sample of buildings.
- Evaluate transferability of monitoring data to represent all segments in the MTLC market.
- Use standard techniques and tools to analyze the data.
- Collect on-line metering data, consolidate into one database, analyze for extrapolation to larger population segments, and add to project report that documents results from sub-metering/building performance monitoring study.
- Prepare a Sub-metering and Building Monitoring Report including, but not limited to, collected metering data consolidated into one data base for analyses.

Deliverables:

- Sub-metering and Building Monitoring Report (no draft)

SYNTHESIS OF RESULTS

Task 1.10 Develop Single Integrated Dataset to Characterize the MTLC Market

The goal of this task is to combine all of the data collected in this project (primary and secondary) into a single database from which data can be drawn to describe any aspect of the MTLC market. This task will combine data gathered from the building monitoring efforts (Tasks 1.6-1.9) with information gathered in the other tasks (Tasks 1.1-1.5). The IOU's and other partner organizations will share data that is not confidential by eliminating customer related information. The project will not have any confidentiality issues with the data.

The Contractor shall:

- Integrate data from primary sources, secondary sources, and sub-metering/load characterization/building performance monitoring.
- Analyze the complete data set using standard methods and techniques, including regression, nearest neighbor, cluster, and/or factor analysis.
- Prepare a Primary, Secondary, and Sub-metering Data Collection Report including, but not limited to integrated and analyzed primary, secondary, and sub-metering data.

Deliverables:

- Primary, Secondary, and Sub-metering Data Collection Report (no draft)

Task 1.11 Analyze Project Results, Synthesize Learning and Refine Perspective

The goal of this task is to synthesize the knowledge gained from this project, revisit the team's initial perspectives of the MTLC market, and refine those perspectives based on lessons learned. The knowledge gained in Project 1 will offer a list of design criteria for technical solutions based on the technical, organizational, and financial realities of various segments of the MTLC market.

The Contractor shall:

- Identify market constraints for each major sub-segment in the MTLC market (defined in Task 1.6); identify the technical and organizational constraints for efficiency product development as determined by the primary data, secondary data and monitoring.

- Develop a list of trigger points in the building management life cycle where energy efficiency retrofit decisions can be initiated.
- Communicate insights with stakeholders in the MTLC market.
- Prepare a MTLC Market Research and Analysis Report including, but not limited to, the detailed results of this task, market constraints, and MTLC life-cycle trigger points.
- Prepare a Final Report summarizing the detailed results of project 1 (Tasks 1.1 to 1.11)
- Participate in a CPR as per Task A.2.

Deliverables:

- MTLC Market Analysis Report (no draft)
- Draft Report on Understanding the Untapped MTLC Markets
- Final Report on Understanding the Untapped MTLC Markets
- CPR Report

Project 2: MARKET DRIVEN TECHNOLOGY DEVELOPMENT – BUILDING- & SITE-LEVEL SOLUTIONS

Task List

The project’s work scope involves the following technical tasks:

| Project & Tasks | CPR | Project & Task Names |
|------------------|-----|--|
| Project 2 | | MARKET DRIVEN TECHNOLOGY DEVELOPMENT – BUILDING- & SITE-LEVEL SOLUTIONS |
| Task 2.1 | | Identify Existing and Emerging Building Envelope and Exterior Lighting Technologies for MTLC Applications |
| Task 2.2 | | Evaluate Performance Improvements, Energy Savings, Environmental Impacts, and Price to Stakeholders of Existing and Emerging Envelope and Exterior Lighting Technologies |
| Task 2.3 | | Identify Potential Product Improvement Opportunities and Work in Collaboration with Manufacturers on Exterior Envelope and Exterior Lighting Technologies |
| Task 2.4 | | Experimental Design, Technology Installation and Instrumentation for Evaporative Cooling and Load Management Technologies |
| Task 2.5 | | Collect, Analyze and Archive Data on Retrofit RTU Load Management Technology |
| Task 2.6 | | Collect, Analyze and Archive Evaporative Cooling Data |
| Task 2.7 | | Produce Production Readiness Plan |
| Task 2.8 | X | Develop, Conduct and Synthesize Market Research Study |

Task 2.1 Identify Existing and Emerging Building Envelope and Exterior Lighting Technologies for MTLC Applications

The goal of this task is to examine existing and emerging technologies that address building envelope and exterior lighting retrofit applications with a focus on characterizing the performance of the technologies. Building envelope includes building walls, facades, shading systems, vegetation, security and emergency requirements, pathways and sidewalks, roof composition, and building windows. Exterior lighting includes parking lot lighting and advertising signage.

The Contractor shall:

- Identify existing and emerging products based on market characterization results of Project 1 that address building and site level envelope and lighting retrofit applications. Such technologies will include shading systems, such as awnings, overhangs and high solar reflectance paints and finishes, as well as innovative light sources, such as solid-state lighting or next-generation induction luminaires, with integrated occupancy and photo sensor bi-level controls for additional energy savings.
- Identify important performance and operational attributes used to characterize the performance of exterior envelope and lighting solutions in this market sector. These attributes may include, but will not necessarily be limited to, solar reflectance and shading masks for envelope systems and system efficacy, light distribution, light quality including color rendering index (CRI), correlated color temperature (CCT) and luminance ratios, lumen depreciation, system life expectancy for lighting systems, and controls and control integration. Once applicable envelope and lighting characteristics and associated metrics are identified, these system parameters will be prioritized based on their value to stakeholders.
- Prepare a matrix of exterior envelope and lighting technologies for retrofit applications: The Prime Contractor team will prepare a portfolio of available envelope and lighting solutions that may be implemented in exterior envelope and lighting retrofit projects in commercial centers. The portfolio will include key attributes and metrics required to rate performance. These solutions will include a range of envelope and lighting products such as high solar reflectance finishes, awnings, overhangs and vegetation for envelope, and High Intensity Discharge (lamps, ballasts)(HID) , fluorescent, Light Emitting Diode (LED), induction and controls technologies for lighting.
- Prepare an Existing and Emerging Building Envelope and Exterior Lighting Report including, but not limited to, addressing building and site level envelope and lighting retrofit applications.

Deliverables:

- Existing and Emerging Building Envelope and Exterior Lighting Report (no draft)

Task 2.2 Evaluate Performance Improvements, Energy Savings, Environmental Impacts, and Price to Stakeholders of Existing and Emerging Building Envelope and Exterior Lighting Technologies

The goal of this task is to characterize building envelope and lighting solutions identified in Task 2.1. It will include evaluation of energy savings and environmental impact relative to a series of typical baseline conditions through laboratory testing and simulations. The results will be used to create a matrix of effective exterior envelope and lighting solutions that satisfy a variety of stakeholder needs in retrofit and renovation situations.

The Contractor shall:

- Evaluate performance improvements of viable envelope and lighting technologies based on the key performance attributes identified in Task 2.1. Each technology will be compared against the performance of baseline technologies currently employed in the MTL sector.
- Evaluate energy savings that will include the reductions in demand kilo Watt (kW), overall energy consumption kilo Watt per hour (kWh), and associated cost savings.
- Evaluate environmental impacts to address the project's impact on key environmental areas, such as green house gas emissions, mercury reduction, and light pollution. Cooling and lighting uses electrical energy; therefore, energy savings will allow the project team to determine the impact of these technologies on green house gas emissions. Electricity use will be converted into carbon dioxide equivalents (CO_{2e}) based on regional conversion factors. This will allow comparison of emissions between the new and baseline technologies. Other environmental factors, such as mercury and light pollution reductions, are a function of the individual lamp and fixture combination. These factors will be compared to the corresponding metrics of baseline conditions.
- Evaluate price to stakeholders: This task will provide information about the price to each stakeholder in the value chain of a technology (manufacturer, distributor, installer and customer). The information will be used by the market research team in Task 2.8 to conduct a value chain analysis in conjunction with a model to determine the value-proposition for each market stakeholder.
- Develop matrix to capture results of evaluation: A matrix that captures the results of the evaluation of retrofit exterior envelope and lighting technologies compared to multiple building baseline scenarios will be developed. Provide matrix of results to the program team for use in Project 4.
- Provide demonstration of technology for market research component: Samples of innovative envelope and lighting technologies will be provided by project partners to the market research group. These products will be used to facilitate open discussion on the attributes and operational characteristics valued by stakeholders.
- Prepare an Energy Savings and Environmental Impacts of Building Envelope and Lighting Solutions Report including, but not limited to, a matrix that lists product performance improvements, energy savings, operational and maintenance savings, and the environmental impacts of the exterior envelope and lighting technology solutions.

Deliverables:

- Energy Savings and Environmental Impacts of Building Envelope and Lighting Solutions Report (no draft)

Task 2.3 Identify Potential Product Improvement Opportunities and Work in Collaboration with Manufacturers on Building Envelope and Exterior Lighting Technologies

The goal of this task is to improve on existing building envelope and lighting technologies. Opportunities to improve certain attributes, that can potentially result in higher levels of energy savings, such as integrated controls capabilities, will be discussed with manufacturing partners and incorporated into the product offerings, where appropriate, in order to enhance the matrix of solutions. This goal includes an energy savings evaluation of the new technology improvements that addresses demand kW reduction and overall energy consumption kWh reduction.

The Contractor shall:

- Identify product improvement opportunities: Receive and analyze feedback from the market research component. Identify opportunities to improve viable technologies, such as integration of innovative controls that can potentially result in higher levels of savings and better fit the needs of MTLC market stakeholders. Examine alternative envelope improvements as well as light sources and fixture designs that may provide additional savings beyond those currently existing in the commercial market.
- Collaborate with manufacturing partners to adapt technologies: Project team will collaborate with manufacturing partners to bring newly identified innovations to market through their existing or emerging product lines. The possible breadth of product improvements may span multiple industries, and the project team will leverage existing relationships in diverse market sectors to implement desired changes in existing technologies. It will also provide technical support to manufacturers, and act as liaison to industries when necessary. In addition, it will provide laboratory testing and independent evaluation of all adaptations and innovations incorporated by project partners in order to provide the most value to MTLC stakeholders.
- Prepare a Product Improvement and New Product Line Report including, but not limited to, analyzing market research and collaborating with manufacturing partners to adapt technologies.

Deliverables:

- Product Improvement and New Product Line Report (no draft)

RETROFIT EVAPORATIVE COOLING AND LOAD MANAGEMENT TECHNOLOGIES FOR PACKAGED ROOFTOP UNITS (RTUS)

Task 2.4 Experimental Design, Technology Installation and Instrumentation for Evaporative Cooling and Load Management Technologies

The goals of this task are to prepare plans for the testing and demonstration, install the systems at Prime Contractor site, and prepare for the experiments. A planning document will be prepared, mechanical systems will be designed, and instrumentation lists will be developed. The mechanical equipment and test instruments will be acquired and installed, and readiness for testing will be assured. The use of the Key Partner technology to support this effort will be included in the experimental design.

The Contractor shall:

- Develop experimental plan: A written “Experimental Plan” will be developed to ensure that the project will yield complete and accurate results. This plan will include information such as test objectives, systems to be tested, monitoring plan/schedule, instrumentation list, test point diagram, uncertainty analysis, data acquisition approach, and plans for analysis and reporting. This document will also include the mechanical design for the systems to be installed, which will be developed in consultation with the technology manufacturers.
- Procure mechanical equipment and instruments: A significant quantity of mechanical equipment and instruments must be acquired for the testing. The mechanical systems will be provided by the technology developers, however, peripheral equipment (such as pumps, piping, and fittings) will need to be acquired. A system/protocol will be developed to easily switch operation between different technology combinations. This will require installation of diverting valves and actuators, and developing a Labview application to control them. Monitoring instruments will be crucial for this project, and they will be carefully selected for appropriateness and required accuracy.
- Install and commission mechanical equipment and instruments: Installation of the systems and instrumentation will be performed by project staff and technology providers. Commissioning will involve a methodical process of inspection and testing of individual of components, followed by functional testing and short-term performance monitoring in all different modes of operation.
- Prepare an Experimental Plan, Equipment Installation, and Commissioning Report including, but not limited to, development of an experimental plan, procurement, installation, and commissioning of equipment.

Deliverables:

- Experimental Plan, Equipment Installation, and Commissioning Report (no draft)

Task 2.5 Collect, Analyze and Archive Data at UC Davis on Retrofit RTU Load Management Technology.

The goals of this task are to collect data on performance of the RTU Load Management system applied to evaporative cooled units, assure quality of the collected data, ensure that any data or instrumentation problems are caught promptly, and archive the collected data in a way that will facilitate data analysis. Data will be converted to a common format and collected into a central database. An additional goal is to identify any product modifications required to obtain optimal performance of RTUs that have been retrofitted with evaporative cooling technologies.

The Contractor shall:

- Collect, assess and archive data: A procedure will be developed to automatically collect and archive data, and a method will be developed to readily assess data quality. The installation will be configured to operate the Load Management technology under base-case conditions (i.e. without benefit of the evaporative technologies), and then with different evaporative technologies. This will be done over a period of up to 6 months to include a range of conditions, such as high temperature periods, and “shoulder” periods when cooling loads are minimal. Data will be continually assessed and periodically exported for interim analysis.
- Document the performance of existing Load Management technology, recommended changes to its performance characteristics, and any data taken with the modified performance characteristics.
- Prepare a report on the Performance of Existing Load Management Technologies Report to include, but not limited to, documenting the performance of existing Load Management technologies.

Deliverables:

- Existing Load Management Technologies Performance Report (no draft)

Task 2.6 Collect, Analyze and Archive Evaporative Cooling Data

The goal of this task is to collect data on the performance of different evaporative cooling systems that are tested, ensure that any data or instrumentation problems are caught promptly, evaluate appropriateness of the technologies in the retrofit of MTLC facilities and utility energy efficiency programs, and archive the collected data in a way that will facilitate future analysis of the data.

The Contractor shall:

- Prepare data analysis report: Data will be periodically exported for interim analysis according to plans established earlier. The team will calculate factors such as system capacity and energy use at different loads, water use per ton-hour, peak kW/ton. Data tables will be produced with these and other factors, documenting the results of the testing.

- Prepare technology evaluation: The project team will evaluate the performance of the technologies. This evaluation will include assessment of capacity impacts, estimation of annual energy and peak demand savings, identification of issues affecting sustainment of energy savings, and consideration of installation and maintenance requirements. An overall assessment will be made, and recommendations for incorporation into the retrofit MTLC package, and/or the California IOU or Emerging Technology (ET) programs, will be drawn.
- Characterize attributes: The team will document the performance and operational attributes of the technologies, and provide this information to the market research team. This information will be based upon the Technology Evaluation, but will be formatted for easy inclusion in market research activities. Important technology attributes will be prioritized for market research component (Task 2.8).
- Provide a demonstration: Prime Contractor facility will host the market research component for major groups of market stakeholders who may provide feedback on the demonstrated technologies.
- Identify technology improvements: The team will identify feasible technology improvement opportunities and work with the technology developers to incorporate them into their product designs.
- Prepare a Technology Performance and Product Improvement Report including, but not limited to recommended product improvement changes leading to energy, operational, and maintenance savings.

Deliverables:

- Technology Performance and Product Improvement Report (no draft)

Task 2.7 Produce Production Readiness Plan

The goal of this task is to work with the technology developers to prepare a plan for commercialization of the technologies.

The Contractor shall:

- Prepare a Production Readiness Plan: The team will work with the technology developers to develop a Production Readiness Plan that will include, but not be limited to:
 - Identification of critical production processes, equipment, facilities, personnel and support systems that will be needed to produce a commercially viable product;
 - A projected cost of production:
 - The investment threshold to launch the commercial product;
 - An implementation plan to ramp up to full production.
- Prepare a Production Readiness Report including, but not limited to, identification of critical production processes for product commercialization, implementation sequence, and product launch.

Deliverables:

- Production Readiness Report (no draft)

Task 2.8 Develop, Conduct and Synthesize Market Research Study

The goal is to evaluate the preferences, values, tradeoffs, and attitudes of market stakeholders related to marketability of the technologies being investigated in this project. Findings from the market research will be communicated back to technology providers to inform product improvement.

The Contractor shall:

- Determine best experts for research: Work with PAC members and other relevant entities to develop and conduct a process to gather individuals to participate in the study. Targeted experts should be individuals that can speak representatively for relevant groups of market stakeholders and the group of subjects selected should be a representative sample of the range of market perspectives.
- Compile a list of factors to evaluate: For each technology studied, compile and prioritize a list of product attributes and non-product factors that influence marketability.
 - Product attributes describe aspects and function of a technology. For an efficient lighting solution these attributes may include descriptors and metrics like light quality, energy savings, dimming range, demand response capability, self commissioning, durability, lifetime, or required frequency of maintenance.
 - Examples of non-product factors include financing options (on-bill, property tax assessment, third party, utility direct install, rebates and incentives), solution bundling (packaging this technology with other relevant technologies), or potential business models for delivery.
- Design data collection methodology: The qualitative research methodology will be designed to present subjects with a technology prototype, demonstration, or description as a stimulus to motivate response about the attributes and factors of interest. The survey will be designed to produce relevant statistical outputs and correlate well to the MTLC sector.
- Create/acquire prototypes for Market Research study: The study will present subjects with technology prototypes, demonstrations, and/or descriptive displays as stimulus to motivate response about particular attributes of a technology. Some of the subjects include end users, tenants, property managers, building owners, installers, distributors, manufacturers, technology developers, financiers, utilities, and policy makers. These prototypes or demonstrations, many of which will be contributed in-kind by our technology development and manufacturing partners, will be delivered to our utility partners' Technology Centers for use in the studies.
- Conduct primary data collection: Data collection will occur in California markets.
- Analyze data: The analysis will yield quantitative characterization of the value of each product attribute, as well as an evaluation of which market related factors best improve the likelihood of success for energy efficiency retrofits in this market. Conclusions will be drawn about the perspectives, needs and motivations of market stakeholders.

- Communicate findings to inform technology development: The knowledge gained through the market research will be communicated to the PAC, Energy Commission, Program Partners, and relevant market stakeholders. The project team will work closely with manufacturers and technology developers to improve their technology offerings based upon the recognized needs of the MTLC market.
- Host and collaborate on the collection of primary data: The Key Partners will assist in the data collection with assistance from the Prime Contractor.
- Prepare a Market Based Strategies for MTLC Buildings Report including, but not limited to, data collection, analyses, product attributes, non product factors, perspectives, needs and motivations of market stakeholders.
- Prepare a Draft and Final Project 2 Report summarizing the detailed results of Tasks 2.1 to 2.8.
- Participate in a CPR as per Task A.2.

Deliverables:

- Market Based Strategies for MTLC Buildings Report (no draft)
- Draft Project 2 Report on Market Driven Technology Development for Building and Site Level Solutions
- Final Project 2 Report on Market Driven Technology Development for Building and Site Level Solutions
- CPR Report

Project 3: MARKET DRIVEN TECHNOLOGY DEVELOPMENT – TENANT-LEVEL SOLUTIONS

Task List

The project's work scope involves the following technical tasks:

| Project & Tasks | CPR | Project & Task Names |
|------------------|-----|--|
| Project 3 | | MARKET DRIVEN TECHNOLOGY DEVELOPMENT – TENANT-LEVEL SOLUTIONS |
| Task 3.1 | | Identify Existing and Emerging Interior Lighting Technologies for MTLC Retrofit Applications |
| Task 3.2 | | Evaluate Interior Lighting Performance Improvements, Energy Savings, and Price to Stakeholders |
| Task 3.3 | | Identify Potential Product Improvement Opportunities |
| Task 3.4 | | Identify Existing and Emerging Energy Efficient Envelope Products for MTLC Applications |
| Task 3.5 | | Evaluate Envelope Performance Improvements, Energy Savings, Price to Stakeholders |
| Task 3.6 | | Identify Potential Envelope Product Improvement Opportunities |
| Task 3.7 | | Identify Existing and Emerging Control Technologies for MTLC Applications |

| | | |
|-----------|---|--|
| Task 3.8 | | Evaluate Lighting Control Performance Improvements, Energy Savings, Environmental Impacts, Price to Stakeholders |
| Task 3.9 | | Identify Potential Improvement Opportunities |
| Task 3.10 | | Investigate HVAC Equipment Capacity Analysis Tools |
| Task 3.11 | | Develop and Test a Tool for Assessing HVAC Downsizing Potential |
| Task 3.12 | | Performance Testing of Electronic Expansion Valve |
| Task 3.13 | X | Conduct and Synthesize Market Research Study |

INTERIOR LIGHTING SOLUTIONS

Task 3.1 Identify Existing and Emerging Interior Lighting Technologies for MTLC Retrofit Applications

The goal of this task is to research the market for energy efficient interior lighting products that can be adapted to the MTLC market for retrofit, and characterize these products. Examples of energy efficient interior lighting products include fluorescent and LED down lights, high efficiency T5 and T8 fluorescent lighting retrofits, direct/indirect pendants, ceramic metal halide display lighting, and LED display, task, ambient and decorative lighting.

The Contractor shall:

- Identify existing and emerging products from major interior lighting manufacturers.
- Identify important performance and operational attributes of interior lighting technologies. This may include ability to dim, color rendering, start-up time, lifetime. Determine attributes that will be considered in the market research component (Task 3.13) of this project. Prepare a matrix of interior lighting technologies for retrofit applications.
- Prepare a portfolio of available solutions that may be implemented in interior lighting retrofit projects in multi-tenant commercial centers. Key attributes for these technologies will be identified along with the appropriate metrics required to rate their performances. These solutions will include a range of lighting products such as fluorescent and LED down lights, high efficiency T5 and T8 fluorescent lighting, retrofits, direct/indirect pendants, ceramic metal halide display lighting, and LED display, task, ambient and decorative lighting.
- Prepare a Current and Emerging Energy Efficient Interior Lighting Technologies Report including but not limited to, identifying the current range of existing and emerging efficient interior lighting technologies and product attributes fitting for retrofit applications, and a matrix listing the performance and operational attributes necessary for comparison to baseline conditions.

Deliverables:

- Current and Emerging Energy Efficient Interior Lighting Technologies Report (no draft)

Task 3.2 Evaluate Interior Lighting Performance Improvements, Energy Savings, and Price to Stakeholders

The goal of this task is to evaluate the interior lighting technologies identified in Task 3.1 on the basis of performance improvements, energy savings, cost and compatibility. Tenant/building characteristics identified in Project 1 will be used to develop technology and price criteria, against which the identified products will be evaluated.

The Contractor shall:

- Evaluate performance improvements: The performance of viable lighting technologies will be compared against the performance of baseline technologies currently employed in the MTLC sector. Testing and evaluation of technologies will be done in the laboratory as needed.
- Evaluate energy savings: It will include the reductions in demand kW overall energy consumption kWh, and the cost. Operational characteristics that affect these savings will be identified during market research (Task 3.13) and applied here to determine the magnitude of savings.
- Evaluate environmental impacts: The project's impact on key environmental areas such as greenhouse gas emissions, mercury reduction, and light pollution will be evaluated based on the lighting energy savings, and identical metrics of baseline conditions.
- Evaluate cost effectiveness and value to different stakeholders: The costs associated with a technology for all stakeholders (manufacturer, distributor, installer, and customer) will be evaluated. This will be combined with information from performance improvements and energy savings to determine paybacks, lifecycle cost savings, and value to key stakeholders.
- Identify potential for integration with other technologies: The ability to integrate each interior lighting technology with building envelope and control retrofit packages will be identified. For example: Is the interior lighting technology suitable for packaging with tubular daylighting devices and daylighting controls?
- Develop matrix to capture evaluation results: Provide technology samples for market research: Samples of innovative interior lighting technologies will be provided by project partners to the market research group to facilitate open discussion on the attributes and operational characteristics valued by market stakeholders.
- Prepare an Improvement Opportunities for Interior Lighting Technologies Report including, but not limited to, product performance improvements, savings in energy, operational, and maintenance costs, and environmental impacts of the interior lighting technologies and a matrix comparing key parameters and characteristics of existing and emerging interior lighting technologies.

Deliverables:

- Improvement Opportunities for Interior Lighting Technologies Report (no draft)

Task 3.3 Identify Potential Product Improvement Opportunities

The goal of this task is to identify product improvement opportunities and to work with manufacturers to bring these improvements to market. These opportunities will be identified by analyzing the results of Task 3.2.

The Contractor shall:

- Identify product improvement opportunities: Receive and analyze feedback from market research component to identify opportunities to improve technologies that can result in higher levels of savings and better fit the needs of MTLC market stakeholders. Examination of alternative light sources and fixture designs may provide additional savings beyond those currently existing in the commercial market.
- Collaborate with manufacturing partners to adapt technologies: It will include bringing newly identified innovations to market through existing or emerging product lines. The possible breadth of product improvements may span multiple industries, and the project team will leverage existing relationships in diverse market sectors to implement changes in existing technologies.
- Provide technical support to manufacturers, and act as liaison among industries when necessary.
- Provide laboratory testing at the Prime Contractor's site and independent evaluation of all adaptations and innovations incorporated by project partners in order to provide the most value to MTLC stakeholders.
- Prepare a Product Improvement Opportunities Report including, but not limited to, identifying product improvement opportunities, collaborating with manufacturers, and providing laboratory testing, and how to bring the improved products to market.

Deliverables:

- Product Improvement Opportunities Report (no draft)

ENVELOPE SOLUTIONS**Task 3.4 Identify Existing and Emerging Energy Efficient Building Envelope Products for MTLC Applications**

The goal of this task is to identify and characterize energy efficient building envelope products that can be applied to the MTLC market for retrofits. Examples of energy efficient building envelope products include tubular day lighting devices (TDD), skylights, thermally insulating and shading window films, double glazing, window frame insulation, cool roofs, and automated shades/blinds.

The Contractor shall:

- Identify existing and emerging envelope products: Research existing and emerging product offerings from major manufacturers, including, but not limited to, the project partners.
- Identify important technology attributes: Identify important performance and operational attributes of building envelope technologies. This may include heat gain addition or reduction, daylight addition or reduction, glare, and controls for shades.
- Determine attributes that will be studied through market research component. The market research component (Task 3.13) will provide feedback from the MTLC customers on the segment's value of each performance attribute.

- Prepare a portfolio of available building envelope retrofit solutions that may be implemented in multi-tenant commercial centers. Key attributes for these technologies will be identified, along with the appropriate metrics required to rate performance.
- Document the current range of existing and emerging energy efficient building envelope technologies and the product attributes necessary for product comparison, and a matrix of existing and emerging envelope solutions for retrofit applications.
- Prepare an Existing and Emerging Energy Efficient Building Envelope Technologies Report including, but not limited to, documenting the current range of existing and emerging energy efficient building envelope technologies and their product attributes.

Deliverables:

- Existing and Emerging Energy Efficient Building Envelope Technologies Report (no draft)

Task 3.5 Evaluate Building Envelope Performance Improvements, Energy Savings, Price to Stakeholders

The goal of this task is to evaluate the building envelope technologies identified in Task 3.4 on the basis of performance improvements, energy savings, cost and compatibility. The tenant/building characteristics identified in Project 1 will be used to develop technology and price criteria, and then determine how the identified products measure up against these criteria.

The Contractor shall:

- Evaluate envelope performance improvements: Viable building envelope retrofit technologies will be compared against the performance of baseline technologies currently employed in the MTLC sector using the key performance attributes identified in Task 3.4. Testing and evaluation of technologies will be done in the laboratory as needed.
- Evaluate energy savings: Energy savings evaluation will include demand kW reduction, overall energy consumption kWh reduction, and cost savings. Operational characteristics that affect these savings will be identified during market research and applied here to determine the magnitude of savings.
- Evaluate environmental impacts: This will address the project's impact on key environmental areas such as greenhouse gas emissions, mercury reduction, and light pollution. Energy savings will allow determining the greenhouse gas impact, electricity use will be converted into carbon dioxide equivalents (CO_{2e}) based on regional conversion factors, which will allow comparison of emissions among the selected and baseline technologies.
- Evaluate price to stakeholders: Provide information about the price to each stakeholder in the value chain of a technology (manufacturer, distributor, installer and customer). The information will be used by the market research team to conduct a value chain analysis in conjunction with a model to determine the value-proposition for each market stakeholder.
- Identify the potential for integration of each building envelope technology with interior lighting and control retrofit packages.

- Develop a matrix that captures the results of the evaluation of the building envelope technologies compared to multiple baseline scenarios.
- Provide results to the program team for subsequent projects including market research, HVAC Downsizing, and Turn-key Package Development.
- Provide samples of retrofit envelope technologies supplied by project partners to the market research group to facilitate open discussion on the attributes and operational characteristics valued by market stakeholders.
- Document product performance improvements, energy savings, operational and maintenance savings, and environmental impacts of the retrofit building envelope solutions.
- Prepare a matrix that compares the key metrics and characteristics of existing and emerging efficient envelope technologies.
- Prepare a report on Performance Improvements of Building Envelope Retrofit Technologies including, but not limited to, product performance improvements, energy savings, operational and maintenance savings, and environmental impacts.

Deliverables:

- Building Envelope Retrofit Technologies Performance Improvement Report (no draft)

Task 3.6 Identify Potential Building Envelope Product Improvement Opportunities

The goal of this task is to identify the improvement opportunities for the selected envelope technologies for MTLC market and bring these improvements to market.

The Contractor shall:

- Identify opportunities to improve viable technologies that can potentially result in higher levels of savings and better fit the needs of MTLC market stakeholders.
- Collaborate with manufacturing partners to bring newly identified innovations to market through their existing or emerging product lines. The breath of product improvements may span multiple industries, and the project team will leverage existing relationships in diverse market sectors to implement changes in existing technologies. It will also provide technical support to manufacturers and act as liaison between industries when necessary. The Prime Contractor will provide laboratory testing and independent evaluation of all adaptations and innovations incorporated by project partners in order to provide the most value to MTLC stakeholders.
- Prepare a Bringing Building Envelope Opportunities to Market Report including, but not limited to, identifying viable technology opportunities, collaborating with manufacturers, and conducting laboratory testing.

Deliverables:

- Bringing Building Envelope Opportunities to Market Report (no draft)

INTEGRATED LIGHTING SYSTEM CONTROLS

Task 3.7 Identify Existing and Emerging Lighting Control Technologies for MTLC Applications

The goal of this task is to identify and characterize energy efficient lighting, envelope, and energy management control solutions that can be applied to the MTLC market for retrofit. Examples include control devices that dim or turn off lights based on occupancy, available daylight, shade management, demand response, and price signals.

The Contractor shall:

- Identify existing and emerging lighting and building envelope control products from the major manufacturers, including, but not limited to, the project partners.
- Identify important performance and operational attributes of lighting and envelope control technologies. This may include attributes such as communication protocol (wired or wireless), user interface, compatibility with utility demand response programs, and reliability and maintenance.
- Determine attributes that will be studied through market research component (Task 3.13). The market research component will provide feedback from the MTLC customers on the segment's value of each performance attribute.
- Prepare a portfolio of available lighting and envelope system control retrofit solutions that may be implemented in multi-tenant commercial centers. Key attributes for these technologies will be identified, along with the appropriate metrics required to rate the performances of each technology.
- Prepare an Existing and Emerging Lighting and Building Envelope Control Technologies Report, including but not limited to, identifying existing and emerging control technologies, and preparing a technology portfolio.

Deliverables:

- Existing and Emerging Lighting and Building Envelope Control Technologies Report (no draft)

Task 3.8 Evaluate Lighting Control Performance Improvements, Energy Savings, Environmental Impacts, Price to Stakeholders

The goal of this task is to evaluate the control systems technologies identified in Task 3.7 on the basis of performance improvements, energy savings, cost and compatibility.

The Contractor shall:

- Evaluate the performance of each lighting and envelope control technology identified in Task 3.7 against the performance of baseline technologies currently employed in the MTLC sector.
- Evaluate the demand kW reduction, overall energy consumption kWh reduction, and associated cost savings. Operational characteristics that affect these savings will be identified during market research and applied here to determine the magnitude of savings.

- Evaluate the project's impact on key environmental areas such as greenhouse gas emissions, mercury reduction, and light pollution.
- Provide price information to each stakeholder in the value chain of a technology (manufacturer, distributor, installer and customer). The information will be used by the market research team to conduct a value chain analysis in conjunction with a model to determine the value-proposition for each market stakeholder.
- Identify the potential for integration with other lighting and envelope technologies. For example assess how daylighting controls work in a MTLC space to reduce the electric lighting load and shade controls work in response to daylight and occupancy.
- Develop a matrix that captures the results of the evaluation of lighting and envelope control technologies compared to multiple baseline scenarios.
- Provide demonstrations of lighting and envelope control technologies to the market research group to facilitate open discussion on the attributes and operational characteristics valued by market stakeholders.
- Prepare a report on Performance Improvements of Interior Lighting and Building Envelope Control Technologies including but not limited to, evaluating the performance of each lighting and envelope control technology, kW reduction, overall energy consumption, associated cost savings, the project's impact on key environmental areas, and provide price information to each stakeholder.

Deliverables:

- Interior Lighting and Building Envelope Control Technologies Performance Improvement Report (no draft)

Task 3.9 Identify Potential Improvement Opportunities

The goal of this task is to identify product improvement opportunities for the MTLC market and bring these improvements to market.

The Contractor shall:

- Identify opportunities to improve viable technologies that can potentially result in higher levels of savings and better fit the needs of MTLC market stakeholders.
- Collaborate with manufacturing partners to bring newly identified innovations to market through their existing or emerging product lines.
- Prepare a Product Improvements Opportunities and New Product Lines Report including, but not limited to, identifying opportunities to improve viable technologies and collaborating with manufacturing partners to bring newly identified innovations to market.

Deliverables:

- Product Improvements Opportunities and New Product Lines Report (no draft)

HVAC DOWNSIZING BASED ON LIGHTING/ENVELOPE/EVAPORATIVE RETROFITS

Task 3.10 Investigate HVAC Equipment Capacity Analysis Tools

The goal of this task is to investigate HVAC equipment capacity analysis tools, such as load calculation or performance assessment tools for input data requirement, configuration time, cost effectiveness, sensitivity to input data uncertainty, and accuracy.

The Contractor shall:

- Prepare a list of criteria for evaluating tools that can be used to quantify the potential to reduce the capacity of an RTU. These tools will include resources such as the commercial load calculation manual from the Air-Conditioning Contractors of America (ACCA) Manual and systems/processes for assessing the performance of RTUs. Conduct a literature search and informal industry survey to identify tools and techniques that are suitable for this application.
- Identify the tools that have the most promise for accomplishing the goals of this project.
- Apply at least two of the tools to at least three different RTUs to assess their performance and applicability.
- Provide a summary of sizing data from field tests performed under the verified service provider (VSP) program.
- Conduct accuracy analysis of the various techniques for RTU capacity estimation.
- Prepare a HVAC Equipment Capacity Analysis Tools Report including but not limited to, establishing criteria for evaluating tools that can be used to quantify the potential to reduce the capacity of an RTU, conduct accuracy analysis, and provide a summary of sizing data from field tests.

Deliverables:

- HVAC Equipment Capacity Analysis Tools Report (no draft)

Task 3.11 Develop and Test a Tool for Assessing HVAC Downsizing Potential

The goal of this task is to develop a simplified decision support tool for assessing and quantifying the potential for downsizing the HVAC equipment for a given tenant, based upon load reduction from envelope and lighting retrofits, and capacity increases from evaporative pre-cooling.

The Contractor shall:

- Develop a tool to assess the potential and strategies for downsizing HVAC equipment. This tool will include consideration of:
 - adequacy of existing equipment capacity,
 - load reductions from lighting and envelope improvements,
 - load reductions from downsizing and “swarm-logic” HVAC control,
 - capacity improvements to the existing HVAC equipment from evaporative pre-cooling (from Project 2),
 - energy savings and demand reduction impacts, and
 - cost effectiveness.

- Review the proposed tool with industry stakeholders and revise it to address comments received.
- Validate the HVAC downsizing tool by testing it at three locations and comparing the results with a more detailed engineering analysis of these buildings.
- Prepare a Prototype RTU Downsizing Assessment Tool Report including, but not limited to developing a prototype tool, reviews its performance and suitability, and lists its performance in simulated applications at customer facilities including performance, usability, accuracy and usefulness.

Deliverables:

- Prototype RTU Downsizing Assessment Tool Report (no draft)

REFRIGERATION EFFICIENCY IMPROVEMENT

Task 3.12 Performance Testing of Electronic Expansion Valve

The goal of this task is to measure the energy savings achieved by retrofitting an existing refrigeration system at the Refrigeration and Thermal Test Center (RTTC) with a Microstaq electronic expansion valve(s). The testing will be performed over a range of operating conditions to develop a robust understanding of the magnitude of the savings and its sensitivity to operating conditions. One key issue to be investigated is how these electronic expansion valves will interface with equipment that is retrofitted with evaporative cooling.

The Contractor shall:

- Design the tests to be performed, including apparatus and test conditions.
- Analyze and interpret the test results, including the likely impact of the technology on the performance of evaporative cooling retrofits.
- Design and construct an experimental apparatus to test the impact of the electronic expansion valves on capacity and efficiency under steady-state and cyclic conditions, with and without using evaporation to cool the air across the refrigeration condenser.
- Analyze and interpret the data covering the general performance of the devices (including quantifying its savings potential), as well as their likely impact on the performance of evaporative cooling retrofits on MTLC-scale refrigeration equipment.
- Document the laboratory test results and their expected implications, addressing whether such valves are a valuable or necessary component of a retrofit package that includes evaporative pre-cooling for refrigeration condensers.
- Prepare an Expansion Valves for Standard and Evaporative Cooling Retrofit Applications Report including, but not limited to, the design and construction of an experimental apparatus, analyze and interpret performance data, and document laboratory tests.

Deliverables:

- Expansion Valves for Standard and Evaporative Cooling Retrofit Applications Report (no draft)

MARKET RESEARCH FOR THE TENANT LEVEL SOLUTIONS

Task 3.13 Conduct and Synthesize Market Research Study

The goal of this task is to design and conduct a study that will engage pertinent market stakeholders to assess their preferences, values, tradeoffs and attitudes related to marketability of the technologies being investigated in this project. The market stakeholder input will be synthesized into a set of recommendations for the technologies being investigated in this project and the integrated-retrofit packages being analyzed in Task 4 and field tested in Task 5.

The Contractor shall:

- Establish participants' list for market research including individuals that can represent the relevant market stakeholders, such as customers, tenants, property managers, building owners, installers, distributors, manufacturers, technology developers, financiers and policy makers.
- Compile a list of factors to be evaluated for each technology studied and each major group of market stakeholders including both product attributes and non-product factors that influence marketability, and prioritize their importance.
 - Product attributes describe aspects and function of a product or technology. Non-product factors are conditions that influence the marketability of a product, such as financing options, utility direct install, rebates, incentives, solution bundling, or potential business models for delivery.
- Design data collection methodology and present the participants a technology prototype, demonstration, or description as a stimulus to motivate response about the attributes and factors of interest.
- Conduct primary data collection in California markets.
- Analyze the results yielding qualitative characterization of the value of each product attribute, as well as an evaluation of which market related factors best improve the likelihood of success for energy efficiency retrofits in this market.
- Communicate findings to program partners and market stakeholders. Project participants from the Prime Contractor will work closely with manufacturers and technology developers to improve their technology offerings based upon the recognized needs for the MTLC market.
- Conduct primary data collection in collaboration with Key Partners.
- Prepare a Market Research for Tenant Level Solutions Report including, but not limited to, compiling a list of factors to be evaluated for each technology studied and each major group of market stakeholders including both product attributes and non-product factors that influence marketability, conduct data collection, and analyze results.
- Prepare a Draft and Final Project 3 Report summarizing the detailed results of Tasks 3.1 to 3.13.
- Participate in a CPR as per Task A.2.

Deliverables:

- Market Research for Tenant Level Solutions Report (no draft)

- Draft Project 3 Report on Market Driven Technology Development for Tenant Level Solutions
- Final Project 3 Report on Market Driven Technology Development for Tenant Level Solutions
- CPR Report

Project 4 TURN-KEY ENERGY EFFICIENCY RETROFIT SOLUTIONS

Task List

The project's work scope involves the following technical tasks:

| Project & Tasks | CPR | Project & Task Names |
|------------------|-----|--|
| Project 4 | | TURN-KEY ENERGY EFFICIENCY RETROFIT SOLUTIONS |
| Task 4.1 | | Review existing Utility Efficiency Audit Programs |
| Task 4.2 | | Develop Approach for First-cut Efficiency Auditing and Decision Support in the MTLC Market |
| Task 4.3 | | Compile and Review Results from Tasks 2, 3 and 4 |
| Task 4.4 | | Build Scenario-based Value Chain and Value-proposition Model |
| Task 4.5 | | Determine Value-proposition by Stakeholder Group for Individual Technology Solutions |
| Task 4.6 | | Develop Turn-key Retrofit Packages of Integrated Solutions for Each Market Sub-Segment |
| Task 4.7 | | Determine Value-proposition by Stakeholder Group for Tailored Package of Solutions |
| Task 4.8 | | Laboratory Testing and Technology Refinement of Integrated Technology Solutions |
| Task 4.9 | X | Synthesis of Results |

DEVELOP INGREDIENTS FOR A SIMPLIFIED BUILDING AUDIT PROGRAM

Task 4.1 Review existing Utility Efficiency Audit Programs

The goal of this task is to gather data from utility partners and other relevant organizations on existing building audit programs and incentivized energy efficiency and demand side management (EE&DSM) technologies that might be applicable to MTLC properties. The IOUs will share data that is not confidential by eliminating customer related information.

The Contractor shall:

- Compile a list of the current MTLC-relevant energy efficiency audit programs, tools, and methods and a list of MTLC applicable EE&DSM technologies that have existing incentive programs.
 - Lists will be assembled by conducting outreach with Key Partners, and energy efficiency advocacy groups.

- Evaluate, on a cursory basis, the benefits, costs and limitations of components, features, and approaches used within each identified audit resource, as well as the benefits and costs by relevant stakeholder for each EE&DSM technology identified.
- Synthesize a state-of-the-art list of best practices for performing energy efficiency audits for MTLC properties.
- Assist in the evaluation of the benefits, costs, and limitations.
- Assist in synthesizing the list of best practices for performing energy efficiency audits of MTLC properties.
- Prepare an Existing Utility Efficiency Audit Programs Report, including, but not limited to, compiling a list of the current MTLC-relevant energy efficiency audit programs, and synthesize a state-of-the-art list of best practices for performing energy efficiency audits for MTLC properties.

Deliverables:

- Existing Utility Efficiency Audit Programs Report (no draft)

Task 4.2 Develop Approach for First-cut Efficiency Auditing and Decision Support in the MTLC Market

The goal of this task is to develop a first-cut approach for auditing MTLC properties and categorizing them into sub-segments. The sub-segments will be defined by the sum of a property's key market characteristics (building type, occupancy, vintage, existing condition, trigger points as well as a number of other factors).

The project team will also develop a tool to support decision-making regarding potential improvements for RTUs that will walk the user through the required input data that is needed and provides a list of recommended improvements.

The Contractor shall:

- Segment the MTLC market by building characteristics (age, type, use, lease agreement, climate zone, etc.).
 - The team will utilize the results from Task 4.1 and Tasks 1-3, and will rely heavily on the load profiles for existing MTLC sites from Task 1, will build on the database developed in the other projects.
- Develop a straightforward approach/model that can be used to categorize specific MTLC properties, based on key characteristics, into common energy efficiency opportunity profile segments.
 - Gather stakeholder input from the program team and program advisory committees on characteristics that will have been determined in Task 1.
 - Utilize regression analyses.
- Document the model in a spreadsheet or other appropriate format to provide a straightforward approach for categorizing MTLC properties.
- Provide internal data that is applicable to segmenting the MTLC market, based on results from Task 1.

- Prepare a First-cut Efficiency Auditing and Decision Support Report including but not limited to categorization of MTLC Properties into Sub-segments, development of a model to categorize specific MTLC properties based on key characteristics into common energy efficiency opportunity profile segments, and segmenting the MTLC market by building characteristics (age, type, use, lease agreement, climate zone, etc.).

Deliverables:

- First-cut Efficiency Auditing and Decision Support Report (no draft)

DEVELOP PACKAGES OF TURN-KEY ENERGY EFFICIENCY RETROFIT SOLUTIONS

Task 4.3 Compile and Review Results from Projects 1, 2 and 3

The goal of this task is to gather required data for conducting Tasks 4.4 through 4.9. This data will come from Tasks 4.1 and 4.2, as well as from Projects 1, 2 and 3, and will include technological solutions for building envelope, lighting, HVAC and controls, as well as business and marketing solutions that will guide the process of developing integrated packages targeting specific MTLC market segments.

The Contractor shall:

- Identify variables and data, collected in Tasks 1-4, that will be useful in the effort to develop packages of turn-key EE&DSM retrofit solutions, including:
 - List of stakeholder groups (i.e. tenants, owners, installers, manufacturers, etc), determined in Task 1.
 - List of MTLC sub-segments with common energy-efficiency opportunity profiles, and the key characteristics used in categorizing the sub-segments (climate zone, existing building condition, type of business, etc.), determined in Task 1 and Task 4.2.
 - List of both newly developed and existing EE&DSM technology measures (i.e.: evaporative cooling retrofit, advanced lighting controls, insulation improvements, etc.), determined in Tasks 2 and 3, as well as Task 4.1.
 - List of product/service attributes (i.e., level of service, user interface, financing options, etc), determined in Task 1.
- Review the above lists and identify any significant knowledge gaps.
- Prepare a Key Variables for Turn-key Retrofit Solutions Report, including, but not limited to, lists of key stakeholder groups, sub-segments, EE/DSM measures, and product attributes.

Deliverables:

- Key Variables for Turn-key Energy Efficiency Retrofit Solutions Report (no draft)

Task 4.4 Build Scenario-based Value Chain and Value-proposition Model

This task will build the framework of a value-proposition modeling tool that will employ a scenario-based approach to produce quantitative cost-benefit analyses by stakeholder group (as defined in Task1), by market sub-segment (as defined in 4.2), and as determined by available financing and market deployment mechanisms (as defined in Task 1).

The Contractor shall:

- Utilize a spreadsheet or appropriate database to build a value-proposition model that will produce quantitative cost-benefit projections for key stakeholder groups, MTLC sub-segments, EE&DSM technology measures, and product/service attributes. The software tool will:
 - perform scenario-based analyses.
 - utilize data compiled in Task 4.3.
 - build result matrices based on values of the input variables.
 - allow for key variables to be adjusted to accommodate customization and improvement of the model.
- Refine the value-proposition model with feedback gathered in Task 4.5.
- Document the development, outputs, and user requirements of the model.
- Prepare Draft and Final Value Proposition Tool Reports including, but not limited to, designing a value proposition model for MTLC, quantitative cost-benefit analyses by stakeholder group, by market sub-segment, and as determined by available financing and market deployment mechanisms.

Deliverables:

- Draft Scenario-Based Value Proposition Tool Report
- Final Scenario-Based Value Proposition Tool Report

Task 4.5 Determine Value-proposition by Stakeholder Group for Individual Technology Solutions

This task will utilize the value-proposition modeling tool developed in task 4.4 to generate cost-benefit calculations for individual EE&DSM technologies by stakeholder group, market segment, and available financing and market deployment mechanisms.

The Contractor shall:

- Utilize the Value Proposition model to conduct cost benefit analyses by stakeholder group for each individual EE&DSM retrofit technology solution. Data for each individual solution will be gathered from Task 2, 3, and 4.1.
- Calculate projected rebates and incentives that may be appropriate for each EE&DSM technology solution.
- Prepare a Stakeholder Value Proposition Model Report including, but not limited to, developing cost benefit analysis by stakeholders for EE&DSM retrofits.

Deliverables:

- Stakeholder Value Proposition Model Report (no draft)

Task 4.6 Develop Turn-key Retrofit Packages of Integrated Solutions for Each MTLC Market Sub-Segment

The goal of this Task is to develop optimized comprehensive turn-key retrofit packages of EE&DSM technology solutions based on cost benefit to all key stakeholder groups that are appropriate for the various sub-segments of the MTLC market.

The Contractor shall:

- Gather stakeholder feedback to identify components of the turn-key packages. Market research design will also include efforts in Task 4.9.
- Develop a series of technology bundles for various MTLC market sub-segments
 - Bundles will consist of the individual EE&DSM technologies to produce the expected improvements.
 - Use results from Task 4.5 to determine technology bundles.
 - Use Delphi analysis (or alternative appropriate market research method) to gather stakeholder input to form the technology bundles.
- Explore and recommend the most strategic financing mechanism and market deployment strategies for each bundle.
 - Use findings from Task 1 to recommend financing and market deployment strategies.
 - Use Delphi analysis (or alternative appropriate market research method) to gather stakeholder input on financing and market deployment strategies.
- Facilitate the deployment of the Delphi method (or alternative appropriate market research method) for conducting the research with Key Partners.
- Prepare a report on Turn-key Retrofit Packages and Integrated Technology Bundles for MTLC including, but not limited to, stakeholder feedback of the turn-key packages, the deployment of the Delphi method (or alternative appropriate market research method), Recommendation on the most strategic financing mechanism, and determinations of technology bundles for various MTLC market sub-segments.

Deliverables:

- Turn-key Retrofit Packages and Integrated Technology Bundles Report (no draft)

Task 4.7 Determine Value-proposition by Stakeholder Group for Tailored Package of Solutions

The goal is to generate cost-benefit calculations for all integrated EE&DSM technology packages within the context of recommended financing and market deployment mechanisms.

The Contractor shall:

- Utilize the Value Proposition model created in Task 4.4 to perform cost benefit analyses by stakeholder groups for each of the turn-key packages of retrofit EE&DSM technologies developed in Task 4.6.
- Compare the cost-benefit differentials for key stakeholder groups between installing the package and the list of individual technologies that made up the packages.
 - This cost differential represents the inherent value of the integrated approach of this research program, identifying cost savings that can be attributed to integrating the lighting & HVAC technologies, and integrating over multi-tenant sites, as well as financing and market deployment strategies.

- Calculate projected rebates and incentives that may be appropriate for each EE&DSM technology package of solutions.
- Add data to Value Proposition for Retrofit Packages and document the value of integrated energy efficiency technology solutions.
- Prepare a Cost/Benefit and Value Proposition Report including, but not limited to, comparing the cost-benefit differentials for key stakeholders, calculating projected rebates and incentives, and documenting the value of integrated energy efficiency technology solutions.

Deliverables:

- Cost/Benefit and Value Proposition Report (no draft)

Task 4.8 Laboratory Testing and Technology Refinement of Integrated Technology Solutions

The goal of this task is to build and test in a laboratory setting the identified integrated packages of technology solutions. These packages will be used as a resource for Task 5. Results from the laboratory testing will be used to refine the ultimate integrated retrofit packages and the value-proposition models developed in Tasks 4.6 and 4.7.

The Contractor shall:

- Choose for testing and refinement a discreet number of the identified turn-key packages of retrofit EE&DSM technology solutions.
 - The packages will be chosen based on the characteristics and MTLC market sub-segments of the likely field research sites in Task 5.
- Build prototypes of the packages.
- Use the prototypes for market research.
- Troubleshoot and refine integration of technologies within the turn-key packages.
- Document results of laboratory tests, including but not limited to, technology integration, laboratory testing, package selection process, testing, prototyping, troubleshooting, and refinement process.
- Prepare Draft and Final Test Plan for Integrated Retrofit Solutions Reports including, but not limited to, testing and a discreet number of the identified turn-key packages of retrofit EE&DSM technology solutions.

Deliverables:

- Draft Test Plan for Integrated Retrofit Solutions Report
- Final Test Plan for Integrated Retrofit Solutions Report

Task 4.9 Synthesis of Results

The goal of this task is to synthesize the lab test results.

The Contractor shall:

- Develop and prepare a Laboratory Test Results Analysis and Recommendations Report specific to each stakeholder group regarding turn-key integrated packages of retrofit E&DSM solutions in MTLC market sub-segments. Recommendations will:

- Provide scenario-based perspective to choosing technology packages.
- Consider technology packages within the context of market deployment and financing strategies.
- Conduct outreach activities to communicate results to stakeholders. These activities will include presentations on MTLC buildings at UC Davis, IOU technology centers, and conferences.
- Write two to four white papers for conferences including the American Council for an Energy Efficient Economy (ACEEE) Summer Study on Buildings and the Building Owner and Operators Association (BOMA) and make presentations to stakeholder groups.
- Write technical papers and present at conferences.
- Prepare Draft and Final Reports on Turn-key Energy Efficiency Retrofit Solutions, including but not limited to, developing recommendations for stakeholder groups for turn-key retrofit packages, the detailed results of project 4 (Tasks 4.1 to 4.9). .
- Participate in a CPR as per Task A.2.

Deliverables:

- Laboratory Test Results Analysis and Recommendations Report (no draft)
- Copies of Presentations Made to Stakeholder Groups
- Copies of 2-4 White Papers
- Copies of technical publications
- Draft Report on Turn-key Energy Efficiency Retrofit Solutions
- Final Report on Turn-key Energy Efficiency Retrofit Solutions
- CPR Report

Project 5 FULL SCALE FIELD RESEARCH OF WHOLE-BUILDING RETROFITS

Task List

The project’s work scope involves the following technical tasks:

| Project & Tasks | CPR | Project & Task Names |
|------------------|-----|--|
| Project 5 | | FULL SCALE FIELD RESEARCH OF WHOLE-BUILDING RETROFITS |
| Task 5.1 | | Test Site Identification |
| Task 5.2 | | Retrofit Solution Design and Specification |
| Task 5.3 | | Retrofit Package Installation and Commissioning |
| Task 5.4 | | Retrofit Packages Performance Monitoring |
| Task 5.5 | | Data Analysis and Reporting |

Task 5.1 – Test Site Identification

The goal of this task is to identify at least three sites for full-scale demonstrations of the recommended technologies. The sites will be selected to represent different market sub-segments within the MTLC market and different climate zones.

The Contractor shall:

- Collaborate with local governments, industry partners and PAC members, to identify sites for the turn-key energy efficiency retrofit demonstrations.
- Select at least one test site with each of the three Key Partners.
- Document the criteria used to select the sites and justification for each chosen site.
- Prepare a Draft and Final Site Selection Report including, but not limited to, the site selection criteria, list of selected sites, explanation of how the selected sites represent different climate zones and MTLC market sub-segments.

Deliverables:

- Draft Site Selection Report
- Final Site Selection Report

Task 5.2 – Retrofit Solution Design and Specification

The goal of this task is to design and specify the retrofit solutions to be installed at the test sites including the financing mechanism for installations. The team will strive to employ a different financing mechanism (direct install, AB811 property tax program, on-bill financing, or other) for each demonstration site.

The Contractor shall:

- Utilize the audit tools from Task 4 to select the retrofit packages.
- Design and specify the retrofit packages for installation at the test sites. Adhere to standard engineering practices for design and specification.
- Prepare Draft and Final Retrofit Packages Design and Specification Reports including, but not limited to, utilizing audit tools from Task 4 for installation at test sites.

Deliverables:

- Draft Retrofit Packages Design and Specification Report
- Final Retrofit Packages Design and Specification Report

Task 5.3 – Retrofit Package Installation and Commissioning

The goal of this task is to install and commission the retrofit solutions.

The Contractor shall:

- Install the retrofit packages at the test sites.
- Adhere to local, state, and federal codes and regulations.
- Prepare Draft and Final Retrofit Packages Installation and Commissioning Reports including, but not limited to, installation of retrofit packages at test sites.

Deliverables:

- Draft Retrofit Packages Installation and Commissioning Report
- Final Retrofit Packages Installation and Commissioning Report

Task 5.4 – Retrofit Packages Performance Monitoring

The goal of this task is to evaluate system performance before and after implementing the retrofit solutions at the test sites to validate their technical performance and cost-effectiveness.

The Contractor shall:

- Develop a monitoring, measurement, and verification plan.
 - The field measurements chosen will capture the key parameters needed to characterize retrofit system performance as well as synergistic effects on whole building energy savings.
 - The measurement and verification plan will be designed to yield statistically significant data that is representative of energy use characteristics for the sites and installations being monitored.
 - The measurement and verification plan will be designed so that data can be correlated with knowledge about whole building energy use for multiple years to yield an accurate characterization of energy system consumption patterns.
 - The monitoring plan will be designed and installed in accordance with industry standard M&V protocols, which may include American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Guideline 14: Measurement of Energy and Demand Savings, the Greenhouse Gas Protocol for Project Accounting, the CPUC's California Energy Efficiency Evaluation Protocols, and the IPMVP.
- Install monitoring equipment at each demonstration site prior to installation and commissioning of retrofit solutions.
 - Instrumentation and data acquisition strategies will vary based on type, extent, and quality of data needed. Data acquisition may range from simple stand-alone data logging to web-enabled real time data monitoring.
- Conduct monitoring, collect data, and consolidate information into a standard format for presentation and analysis.
- Prepare a report including, but not limited to system performance before and after implementing the retrofit solutions at the test sites to validate their technical performance and cost-effectiveness.
- Prepare Draft and Final Retrofit Packages Performance Reports including but not limited to, before and after measurement and monitoring results, monitoring, measurement, and verification plan, installation and commissioning of monitoring equipment and integrated retrofit solutions.

Deliverables:

- Draft Retrofit Packages Performance Report
- Final Retrofit Packages Performance Report

Task 5.5 – Data Analysis and Reporting

The goal of this task is to conduct data analysis and reporting that documents the results of the retrofit solutions and identifies potential improvements. Results will be used to refine the modeling tools developed in Task 4 (specifically Task 4.8) and will be used to inform IOU programs on how to address the MTLC market.

The Contractor shall:

- Analyze the data from Task 5.4, using industry standard techniques and tools, to determine actual performance of the retrofit solutions, including individual measurement performance and synergistic effects.
- Synthesize the results related to actual performance, investigate any discrepancies from expectations, and identify potential improvements.
- Prepare a Retrofit Packages Data Analysis, Performance and Recommendation Report documenting the results of the retrofit solutions and identifying potential improvements that includes, but is not limited to, actual performance, any discrepancies from expectations, and potential improvements to the solutions and/or analysis tools.
- Prepare a Complete Project Results and Recommended Improvements Report including, but not limited to, analyzing and synthesizing results from Task 5.4.
- Prepare a draft and final Full Scale Field Research of Whole Building Retrofits Report summarizing the detailed results of project 5 (Tasks 5.1 to 5.5).
- Prepare a Draft and Final Program Report per Task A.6 for the entire program that includes Projects 1 to 5, including the detailed results and recommendations produced under the tasks and sub-tasks of projects 1 to 5.

Deliverables:

- Retrofit Packages Data Analysis, Performance and Recommendation Report (no draft)
- Draft Full Scale Field Research of Whole Building Retrofits Report
- Final Full Scale Field Research of Whole Building Retrofits Report
- Draft Program Report
- Final Program Report