

Department of Energy  
**Funds-In Agreement for Research and Development**  
**Appendix A—California Energy Commission**  
**Exhibit A - Statement of Work**  
**Exhibit B - Task Deliverables, Schedule,**  
**Exhibit C - Budget**  
**Exhibit D - List of Contacts And Addresses**  
**Exhibit E - Confidential Deliverables and Intellectual Property Lists**

Prepared by the National Renewable Energy Laboratory  
November 6, 2007

**I. Title of project**

Software Tools for Standards Development & Compliance

**II. California Energy Commission RFP identification**

Not Applicable

**III. Background**

The U.S. Department of Energy has directed the National Renewable Energy Laboratory, NREL, to perform the work stated in this Appendix A for the California Energy Commission. NREL, a laboratory owned by the Department of Energy, is located at 1617 Cole Blvd., Golden, Colorado, 80401. Midwest Research Institute, a not-for-profit corporation organized under the laws of the State of Missouri, with its principal place of business at 425 Volker Boulevard, Kansas City, Missouri, 64110 manages and operates National Renewable Energy Laboratory under DOE Contract No. DE-AC36-99-GO10337. The California Energy Resources Conservation and Development Commission (California Energy Commission) is an agency organized under the laws of the State of California with a principal place of business at 1516 Ninth Street, Sacramento, California 95814.

**IV. Project Goals and Objectives**

**Problem Statement**

Recent and current legislation in California includes aggressive goals to increase energy efficiency and reduce greenhouse gas emissions by significantly increasing the stringency of the Title-24 Building Energy Efficiency Standards (Standards). The California Energy Commission does not currently have the appropriate analysis tools or standards compliance software to integrate new energy efficiency measures into future versions of the Standards.

EnergyPlus is a new-generation building energy simulation program based on two well-known simulation tools originally developed in the 1970s, DOE-2 and Building Load Analysis and System Thermodynamics (BLAST), with numerous added capabilities. The principal advancement from its predecessors is that EnergyPlus simulates loads, systems and plants within the same time step, so important interactions can be accurately modeled. EnergyPlus was developed jointly by Lawrence Berkeley National Laboratory, the University of Illinois, the U.S. Army Construction Engineering Research Laboratory, National Renewable Energy Laboratory, GARD Analytics, Inc., Oklahoma State University and others, with support from the U.S. Department of Energy, Office of Building Technology.

The National Renewable Energy Laboratory (NREL) has developed several software tools to build and run thousands of EnergyPlus simulations for national standards assessments and zero energy building potential studies. This “Analysis Platform” can be highly leveraged to meet the objective listed above.

## **V. Technical and economic/cost performance objectives**

- A. The overall technical goal of this project is to provide the Energy Commission with tools to help develop their energy codes and compliance methods.

The specific, technical objectives upon which this project’s success will be evaluated are:

- Ability for the Commission to navigate through advanced building design criteria and determine their impact on energy across all of California’s climate regions.
- B. The overall economic/cost goal of this project is to help the Commission determine future energy codes with little economic/cost impact by reducing the time needed for energy simulations.

## **VI. Preliminary Activities**

### **1.1 Attend Kick Off Meeting**

The Facility Operator’s Project Manager (Principal Investigator) shall attend a “kick off” meeting with the California Energy Commission Contract Manager to review the California Energy Commission's expectations for: accomplishing tasks described in the work statement; administrative requirements in the terms and conditions of the contract (e.g., invoicing, statements vesting title, prior approvals, data disclosure limitations, monthly progress reporting format and content, etc.); and the California Energy Commission’s roles and responsibilities. The location of this meeting shall be designated by the California Energy Commission Contract Manager.

### **1.2 Describe Synergistic Projects**

See Attachment A-2 to this Exhibit.

### **1.3 Identify Required Permits**

There are no permits required within this agreement.

### **1.4 Obtain Required Permits**

There are no permits required within this agreement.

### **1.5 Prepare Production Readiness Plan**

A production readiness plan is not required within this agreement.

## VII. Description of tasks to be performed

### TECHNICAL TASKS

#### GLOSSARY

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

ACM	Alternative Calculation Method (Title-24)
CBSO	Commission Building Standards Office
CCM	Commission Contract Manager
CPR	Critical Project Review
DOE	Department of Energy
NREL	National Renewable Energy Laboratory
RE	Requirements Engineering
Standards	Title-24 Building Energy Efficiency Standards

#### SCOPE OF WORK

This agreement includes a set of administrative tasks and a set of Technical Tasks. The remainder of this work statement defines these Technical Tasks. Task descriptions include goals, Contractor activities, and deliverables. The deliverables, such as test plans, technical reports and other interim deliverables, for each task are defined to the extent possible, but are subject to change based on recommendations from the Project Manager and the approval of the Commission Contract Manager. The Contractor shall submit a draft of each deliverable, unless described differently 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 5 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 2 working days of receipt. Key elements from this deliverable shall be included in the Final Report for this project.

When creating technical deliverables, the Facility Operator 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>

#### Technical Task List

Task 2.1	EnergyPlus Analysis Platform
Task 2.2	Standards Compliance Rules Editor
Task 2.3	Standards Compliance Engine
Task 2.4	Recommendations for Future Standards

## **Task 2.1 EnergyPlus Analysis Platform**

The goal of this task is to develop and deliver software tools that facilitate the use of EnergyPlus by the Commission Building Standards Office (CBSO) to analyze energy features of buildings, understand the potential statewide energy impacts of building systems and develop recommendations for future Standards.

### **The Contractor shall:**

- Deliver the current version (version 1.0) of NREL’s EnergyPlus Analysis Platform (Analysis Platform) software with installation and operating instructions to the CBSO. NREL and the Energy Commission agree that this delivered software is “Background Intellectual Property” under Appendix B, Section I.
- Train the CBSO staff on the use of the Analysis Platform, and provide any training materials developed.
- Meet with the Commission Contract Manager (CCM) and the CBSO staff to identify and prioritize modifications to the Analysis Platform that will improve analyses of energy saving opportunities for future Standards.
- Develop a Standards Analysis Platform Plan that documents the planned improvements to the software. This plan should include but not be limited to the text description, functional requirements and timeline for completion of each new software capability. The new features will include but not be limited to Analysis Platform software modifications, EnergyPlus input files and/or data libraries for California building prototypes and building energy system descriptions. The Standards Analysis Platform Plan shall include a software feature that takes results from the Rules Editor developed in Task 2.2 and simulates the compliance rules for all California climate zones and building prototypes to assess the energy impact of implementing proposed changes to the Standards.
- Complete the enhancements to the Analysis Platform based on the Standards Analysis Platform Plan. NREL and the Energy Commission agree that this revised version of the software is not “Background Intellectual Property” under Appendix B, Section I. Instead, both parties agree it is both a “Subject Invention” under Appendix B, Section A(1) and “software first produced in performance of this agreement” under Appendix C, Section G(1). As such, NREL has the right to copyright and/or patent it, and the Energy Commission is granted a royalty free, no-cost, non-exclusive, irrevocable non-transferable, worldwide, license to produce the software, and to prepare derivative works for State governmental purposes.
- Document, deliver and test the Standards Analysis Platform at the CBSO.
- Develop an EnergyPlus Modification Plan to include but not be limited to the simulation model changes identified through the processes involved in completing Task 2.1-2.4 that are necessary to use EnergyPlus as the basis for building energy simulations in the Standards.
- Implement and document the EnergyPlus simulation model changes according to the EnergyPlus Modification Plan.
- Supply ongoing email and phone support for the software developed in this subtask for the duration of this Agreement.

### **Deliverables:**

- Analysis Platform version 1.0

- Training Analysis Platform version 1.0 Training Materials
- Standards Analysis Platform Plan
- Standards Analysis Platform
- EnergyPlus Modification Plan
- Documentation of EnergyPlus Modifications

## **Task 2.2 Standards Compliance Rules Editor**

The goal of this task is to develop a software tool and supporting databases that allow the CBSO to define, modify and delete compliance rules that represent the specific requirements of the Alternative Calculation Method (ACM) for Standards compliance. The rules developed by the Rules Editor will be interpreted and implemented by the Compliance Engine developed in Task 2.3.

### **The Contractor shall:**

- Review the 2008 ACM rules documented in the Commission’s Nonresidential Alternative Calculation Method Approval Manual (ACM Manual). Develop a “CEC Ruleset” that delineates each ACM rule without direct reference to a particular building simulation program (e.g. DOE2.1E). Determine the Standards compliance intent of each rule and identify generic performance libraries that are needed. Document the CEC Ruleset in a text-based report.
- In partnership with L’Monte Information Services (a RE firm hired by the Commission through a separate contract), develop a set of software specifications for the Rules Editor, based on the functional requirements previously developed by the Commission.
- Develop and document a “rules language” suitable for creating and modifying building energy efficiency codes and standards within the Rules Editor. Draft a set of rules using this language, based on the CEC Ruleset developed in this Task.
- Prepare a Standards Rules Language Report that delineates the format, syntax, objects and object relationships used to define the compliance rules. This report shall include written explanations of the problem areas that cannot be described with the rules language and recommendations of options to resolve these problems.
- Develop the Rules Editor based on the software specifications developed in this Task.
- Document, deliver, and test the Rules Editor at the CBSO. NREL and the Energy Commission agree that the Rules Editor developed under this task is “Generated Information” under Appendix C, Section (A)(2). As such, and because it is not being disclosed in a Subject Invention disclosure, both parties have “Unlimited Rights” to it under Appendix C, Section C. “Unlimited Rights” is defined in Appendix C, Section (A)(4).
- Supply ongoing email and phone support for the software developed in this subtask for the duration of this Agreement.

### **Deliverables:**

- CEC Ruleset Report
- Software Specifications for Standards Compliance Rules Editor
- Standards Rules Language Report

- Standards Compliance Rules Editor
- Rules Editor Documentation Report

### **Task 2.3 Standards Compliance Engine**

The goal of this task is to develop software that evaluates a proposed building's compliance with the Standards by simulating the energy performance of the building and comparing it to a standard or "budget" building, according to the rules defined in the ACM Manual. The Compliance Engine software will simulate the proposed and budget building according to the rules defined in the Rules Editor developed in Task 2.2.

#### **The Contractor shall:**

- In partnership with L'Monte Information Services, develop a set of software specifications for the Compliance Engine, based on the functional requirements previously developed by the Commission.
- Develop a Compliance Engine that meets the software specifications developed in this Task.
- Develop a simple software interface to the Compliance Engine for use in testing software functionality and CEC Ruleset implementation.
- Document, deliver and test the Compliance Engine at the CBSO. NREL and the Energy Commission agree that the Compliance Engine developed under this task is "Generated Information" under Appendix C, Section (A)(2). As such, and because it is not being disclosed in a Subject Invention disclosure, both parties have "Unlimited Rights" to it under Appendix C, Section C. "Unlimited Rights" is defined in Appendix C, Section (A)(4).
- Supply ongoing email and phone support for the software developed in this subtask for the duration of this Agreement.

#### **Deliverables:**

- Software Specifications for Standards Compliance Engine
- Standards Compliance Engine with simple interface
- Compliance Engine Documentation Report

### **Task 2.4 Recommendations for Future Standards**

The goal of this task is to conduct analysis using the tools developed in Task 2.1, 2.2 and 2.3 to develop recommendations for future changes to the Standards.

#### **The Contractor shall:**

- Meet with the CCM and the CBSO staff to identify and prioritize specific analyses to be performed to advance future building energy efficiency standards.
- Develop an Advanced Standards Analysis Plan that delineates the analyses identified above.
- Conduct analyses according to the Advanced Standards Analysis Plan.
- Prepare the Advanced Standards Recommendations Report that summarizes the results of the analyses performed in this Task.

#### **Deliverables:**

- Advanced Standards Analysis Plan

- Advanced Standards Recommendations Report

### **Task 3.0 Reporting Tasks**

All reports shall be delivered to:  
Accounting Office, MS-2  
California Energy Commission  
1516 9<sup>th</sup> Street, 1<sup>st</sup> Floor  
Sacramento, CA 95814

### **Task 3.1 Quarterly Progress Reports**

The Contractor shall prepare *written* Quarterly Progress Reports to the Commission Contract Manager by the 30th of the following month, starting after the Department of General Service's contract approval date and shall continue each month until the Final Report has been accepted by the Commission Contract Manager. Attachment A-1 provides a recommended format and content requirements for the Monthly Progress Report.

### **Task 3.2 Final Report**

The Final Report shall be a public document. If the Contractor will be preparing a confidential version of the final report as well, the Contractor shall perform the following tasks for both the public and confidential versions of the Final Report. When creating the Final Report, the Facility Operator 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>

#### **Subtask 3.2.1 Final Report Outline**

- Contractor shall prepare and submit to the Commission Contract Manager for review an outline of the Final Report describing the original purpose, approach and results of the project.
- The outline shall be submitted to the Commission Contract Manager for review. The Commission Contract Manager shall determine if the outline is satisfactory. If the Commission Contract Manager determines that the outline is unsatisfactory, he or she will, in a timely manner, provide to the Contractor written comments, which indicate how the outline can be improved. The Contractor shall revise the outline to meet the Commission Contract Manager's requirements. Upon finding the final report outline satisfactory, the Commission Contract Manager shall provide to the Contractor written approval of it.

#### **Subtask 3.2.2 Draft Final Report for Comment**

- The Contractor shall prepare and submit to the Commission Contract Manager a draft Final Report on the project. The format of the report shall follow the approved outline.

- The draft final report shall be submitted to the Commission Contract Manager for review and to determine, in a timely manner, if it is satisfactory. If the Commission Contract Manager determines that it is unsatisfactory, he or she will, provide to the Contractor written comments, which indicate how it can be improved. The Contractor shall revise the draft final report incorporating the Commission Contract Manager's corrections and required changes. Upon finding the revised draft to be satisfactory, the Commission Contract Manager shall provide to the Contractor written approval of it.

### **Subtask 3.2.3 Final Report**

- The Contractor shall prepare Final Report and submit it to the Commission Contract Manager after receiving the Commission Contract Manager's written approval of the draft Final Report. This task shall be deemed complete and accepted by the Commission only when the Commission Contract Manager approves the Final Report in writing. Upon approval, the Contractor shall submit two unbound copies of the Final Report to the Commission Contract Manager.

### **Task 3.3 Final Meeting**

Contractor shall meet with the Commission Contract Manager to present findings, conclusions, and recommended next steps (if any) for the project.

Contractor will also discuss with the Commission Contract Manager the following contract close-out items:

- What to do with any state-owned equipment (Options), if applicable
- Commission's request for specific "generated" data (not already provided in contract deliverables)
- Need to document Contractor's disclosure of "subject inventions" developed under the contract
- Need to file UCC-1 form re: Commission's interest in patented technology
- Other "surviving" contracts provisions.

## **VIII. Critical Project Reviews**

The California Energy Commission will conduct critical project reviews at the conclusion of the following subtasks:

- Task 2.1, after delivery of the Standards Analysis Platform Plan,
- Task 2.2 , after delivery of the Software Specifications for Standard Compliance Rules Editor,
- Task 2.2, after delivery of the Standards Rules Language Report, and
- Task 2.3, after delivery of the Software Specifications for Standards Compliance Engine.

*(Note: Critical project reviews are meetings between the Facility Operator, the California Energy Commission Contract Manager and other individuals selected by the California Energy Commission Contract Manager to provide objective, technical support to the California Energy Commission. The purpose of these meetings is to discuss with the Facility Operator the status of the project and its progress toward achieving its goals and objectives. These meetings may take place at the Energy Commission offices in Sacramento, or at another, reasonable location determined by the California Energy Commission Contract Manager.)*

*(Note: Prior to the critical project review meeting, the Facility Operator will provide the task deliverable(s) to the California Energy Commission Contract Manager sufficiently in advance to allow the Contract Manager's review of the deliverable document(s) before the review meeting. If not already defined in the Work Statement, the California Energy Commission Contract Manager shall specify the contents of the deliverable document(s).)*

*(Note: At the project review meeting, the Facility Operator shall present the required technical information and participate in a discussion about the project with the California Energy Commission Contract Manager and other meeting attendees, if any.)*

*(Note: Following the project review meeting, the California Energy Commission will determine whether the Facility Operator is complying satisfactorily with the Work Statement and whether the project is demonstrating sufficient progress toward achieving its goals and objectives to warrant continued PIER financial support for the project.)*

## **IX. Sponsor's Key personnel and Agreement Management**

- A. The name and area code/phone number of the California Energy Commission's Contract Manager is listed on Exhibit D and is the official technical contact for the California Energy Commission.

The Sponsor's Contract Manager is responsible for the day to day project status, decisions and communications with the Facility Operator Project Manager (Principal Investigator). The California Energy Commission Contract Manager will review and approve all project deliverables, reports, and invoices.

The Sponsor may change the Contract Manager by notice given to the Facility Operator at any time signed by the Contract Officer of the California Energy Commission.

- B. The name and area code/phone number of the California Energy Commission's Contract Officer is listed on Exhibit D and will be the Contract Officer for the Agreement and is the official administrative contact for the California Energy Commission.

## **X. Facility Operator's Key Personnel and Agreement Administration**

The Facility Operator is obligated to comply with the terms and conditions of its Management and Operating (M&O) Contract with the DOE when performing work under this agreement. The DOE may require substitution of the named "key personnel" under this agreement should the DOE determine that the services of the Project Manager (Principal Investigator) or other named key personnel are necessary to meet the Facility Operator's M&O Contract obligations to the DOE. Should the DOE direct the Facility Operator to substitute the named key personnel under this agreement, the Facility Operator shall inform the California Energy Commission of the directed substitution in accordance with paragraphs A and B below. In the event that the California Energy Commission does not concur with the substitution of named key personnel as directed by the DOE, this agreement shall be terminated under Article XX, Termination, of the modified terms and conditions.

- A. The name and area code/phone number of the National Laboratory's Project Manager (Principal Investigator) is on Exhibit D and will be the Project Manager (Principal Investigator) for this project and is the official technical contact for National Renewable Energy Laboratory.

The Facility Operator's Project Manager (Principal Investigator) is responsible for the day to day project status, decisions, and communications with the Sponsor's Contract Manager. The Facility Operator's Project Manager (Principal Investigator) will review and approve all project deliverables and reports.

The Facility Operator's Project Manager (Principal Investigator) is designated as "key personnel" under the Agreement. The California Energy Commission reserves the right to prior written concurrence of any substitution of the Project Manager (Principal Investigator).

- B. The key personnel are listed on Exhibit D in this agreement.  
Facility Operator's key personnel may not be substituted without the California Energy Commission Contract Manager's prior written concurrence. Such concurrence shall not be unreasonably withheld. All other personnel may be substituted by Facility Operator, with written notification made to the California Energy Commission Contract Manager.
- C. The name and area code/phone number of National Laboratory Agreement Administrator is on Exhibit D and will be the Agreement Administrator for this Agreement and is the official administrative contact for National Renewable Energy Laboratory.

#### **XI. Facility Operator's key subcontractors**

The Facility Operator's key subcontractors are listed on Exhibit D in this agreement. Facility Operator's key subcontractors may not be substituted without the California Energy Commission Contract Manager's prior written concurrence. Such concurrence shall be timely provided and not unreasonably withheld. Delay in written concurrence may result in a work stoppage of subcontract work. All other subcontractors may be substituted by Facility Operator, with written notification made to the California Energy Commission Contract Manager.

#### **XII. Report standards**

- A. The report outline and format will be provided by the Sponsor's Contract Manager to the Facility Operator's Project Manager (Principal Investigator).
- B. All reports shall be delivered to the Accounting address shown on Exhibit D.
- C. Progress Reports. The Facility Operator shall prepare a Progress Report that summarizes all Agreement activities conducted by the Facility Operator to date, with an assessment of ability to complete the project within the current budget and any anticipated cost overruns. Each Progress Report is due to the California Energy Commission Contract Manager within 30 days after the end of the reporting period. The California Energy Commission Contract Manager will specify the report format and contents and the number of copies to be submitted.
- D. Final Report and Final Meeting. At the conclusion of the Agreement's technical work as provided for this Appendix A Statement and revised project plan, Facility Operator shall prepare a comprehensive written Final Report, including an Executive Summary. The California Energy Commission Contract Manager will review and approve the Final Report.

#### **XIII. Schedule**

The program will continue for 36 months after advance funding is received by Midwest Research Institute. This Agreement is effective the later date of (1) the date on which it is signed by the last of the parties thereto, or (2) the date on which it is approved by the California Department of General Services as noted on the Standard Agreement, or (3) the date on which the Facility Operator receives advance funding from the Sponsor.

#### **XIV. Budget**

SOW Appendix A, Exhibit C shows California Energy Commission's Reimbursable Budget.

SOW Appendix A, Exhibit C shows the assessed value of the Federal Administrative Charge not charged to this project.

SOW Appendix A, Attachment A-2 shows assessed value of synergistic projects. The assessed value of such synergistic projects does not constitute a funding contribution or obligation (either cash or in-kind) on the part of the DOE or the Facility Operator.