

GRANT REQUEST FORM (GRF)

CEC-270 (Revised 10/2015)

CALIFORNIA ENERGY COMMISSION

New Agreement EPC-15-070 (To be completed by CGL Office)

Division	Agreement Manager:	MS-	Phone
ERDD	Yu Hou	43	916-327-1544

Recipient's Legal Name	Federal ID Number
Altostratus, Inc.	01-0801047

Title of Project
Intra-urban Enhancements to Probabilistic Climate Forecasting for the Electric System

Term and Amount	Start Date	End Date	Amount
	6/1/2016	5/30/2019	\$ 193,326

Business Meeting Information
 ARFVTP agreements under \$75K delegated to Executive Director.

Proposed Business Meeting Date	5/17/2016	<input type="checkbox"/> Consent	<input checked="" type="checkbox"/> Discussion
Business Meeting Presenter	Yu Hou	Time Needed:	5 minutes

Please select one list serve. Select

Agenda Item Subject and Description

ALTOSTRATUS, INC.. Proposed resolution approving agreement EPC-15-070 with Altostratus, Inc. for a \$193,326 grant to fund the development of fine-resolution characterization of intra-urban climate variability and transfer functions to enhance the probabilistic and short-term climate forecasts for the electric system.

California Environmental Quality Act (CEQA) Compliance

1. Is Agreement considered a "Project" under CEQA?
 Yes (skip to question 2) No (complete the following (PRC 21065 and 14 CCR 15378)):
 Explain why Agreement is not considered a "Project":
 Agreement will not cause direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment because it will develop and implement a methodology to improve the representation of urban climate effects in probabilistic climate forecasts for the electric system. The methodology will include computer modeling, data analysis, and development of statistical correlations and transfer functions. Therefore, there are no physical aspects to this agreement.
2. If Agreement is considered a "Project" under CEQA:
 a) Agreement **IS** exempt. (Attach draft NOE)
 Statutory Exemption. List PRC and/or CCR section number: _____
 Categorical Exemption. List CCR section number: _____
 Common Sense Exemption. 14 CCR 15061 (b) (3)
 Explain reason why Agreement is exempt under the above section: _____
- b) Agreement **IS NOT** exempt. (Consult with the legal office to determine next steps.)
 Check all that apply
 Initial Study Environmental Impact Report
 Negative Declaration Statement of Overriding Considerations
 Mitigated Negative Declaration

List all subcontractors (major and minor) and equipment vendors: (attach additional sheets as necessary)

Legal Company Name:	Budget
	\$

List all key partners: (attach additional sheets as necessary)

Legal Company Name:

Budget Information

Funding Source	Funding Year of Appropriation	Budget List No.	Amount
EPIC	14-15	301.001B	\$193,326
			\$
R&D Program Area: EGRO: EA		TOTAL:	\$193,326
Explanation for "Other" selection			

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CALIFORNIA ENERGY COMMISSION



Reimbursement Contract #:				Federal Agreement #:			
Recipient's Administrator/ Officer				Recipient's Project Manager			
Name:	Haider Taha			Name:	Haider Taha		
Address:	940 Toulouse Way			Address:	940 Toulouse Way		
City, State, Zip:	Martinez, CA 94553-3597			City, State, Zip:	Martinez, CA 94553-3597		
Phone:	925-285-5221 /	Fax:	- -	Phone:	925-285-5221 /	Fax:	- -
E-Mail:	haider@altostratus.com			E-Mail:	haider@altostratus.com		

Selection Process Used							
<input checked="" type="checkbox"/> Competitive Solicitation				Solicitation #: GFO-15-309			
<input type="checkbox"/> First Come First Served Solicitation							

The following items should be attached to this GRF							
1. Exhibit A, Scope of Work						<input checked="" type="checkbox"/>	Attached
2. Exhibit B, Budget Detail						<input checked="" type="checkbox"/>	Attached
3. CEC 105, Questionnaire for Identifying Conflicts						<input checked="" type="checkbox"/>	Attached
4. Recipient Resolution					<input checked="" type="checkbox"/>	N/A	<input type="checkbox"/> Attached
5. CEQA Documentation					<input checked="" type="checkbox"/>	N/A	<input type="checkbox"/> Attached

Agreement Manager_____
Date_____
Office Manager_____
Date_____
Deputy Director_____
Date

Exhibit A Scope of Work

I. TASK ACRONYM/TERM LISTS

A. Task List

Task #	CPR ¹	Task Name
1		General Project Tasks
2		Analysis of Observational Weather Data
3	X	Urban Atmospheric Modeling
4		Development of Correlations and Transfer Functions
5		Evaluation of Project Benefits
6		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
CAISO	California Independent System Operator
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CART	Classification and Regression Tree
CDH	Cooling Degree-Hour
Energy Commission	California Energy Commission
CO2	Carbon Dioxide
CPR	Critical Project Review
CPUC	California Public Utilities Commission
FDDA	Four Dimensional Data Assimilation
GIS	Geographic Information System
GFS	Global Forecast System
HDH	Heating Degree-Hour
LULC	Land Use / Land Cover
NCDC	National Climatic Data Center
NOAA	National Oceanic and Atmospheric Administration
PDF	Probability Distribution Function
TAC	Technical Advisory Committee
WRF	Weather Research and Forecasting model

¹ Please see subtask 1.3 in Part III of the Scope of Work (General Project Tasks) for a description of Critical Project Review (CPR) Meetings.

Exhibit A Scope of Work

II. PURPOSE OF AGREEMENT, PROBLEM/SOLUTION STATEMENT, AND GOALS AND OBJECTIVES

A. Purpose of Agreement

The purpose of this Agreement is to provide a high resolution characterization of intra-urban climate variability and develop transfer functions to enhance probabilistic climate forecasts for California's electricity system.

B. Problem/ Solution Statement

Problem

Probabilistic seasonal and decadal regional climate forecasts for the electricity system are typically done at a coarse-resolution and do not accurately reflect urban influences on climate. Even short-term (2-4 weeks) forecasting by utilities is conducted at a relatively coarse scale, but more importantly, these forecasts are based upon models that do not explicitly account for the intra-urban variations in climate that result from effects of urban land use and land cover, heat and cool islands, heat transport, on-shore warming, urban-climate archipelagos, venting, and interaction with processes within the urban boundary layer. These mechanisms can cause intra-urban temperature variations between 1 and 4°C on average in most urban areas in California and can average as large as 10°C in areas such as the Los Angeles basin, San Francisco Bay Area, Santa Clara Valley, and the San Diego region. In such cases, the temperature signal is complex and often a result of superimposed effects from all of the mechanisms mentioned above. Another issue is that current probabilistic forecast models do not account for trends of and changes in the magnitudes of these urban forcing mechanisms under conditions of future climate, changing and future land use patterns and land cover, and excessive heat events. Similarly, such analyses do not take urban effects directly into account and typically interpolate among a network of relatively sparse observational monitors. Because intra-urban climate variations can be significant, it is important to explicitly account for them in the seasonal, decadal, and short-term forecasts of the electric system that serve as a basis for electricity planning by the Energy Commission and the utilities.

Solution

This project will develop and implement a methodology to improve the representation of urban climate effects in probabilistic, forecasts for the electric system. It will quantify intra-urban climate variability (at census tract or finer resolution) in California for inclusion into forecasts used by the Energy Commission and utilities. The project will focus on California summer conditions and initially up to 4 urban areas where intra-urban climate variability is significant, i.e., the San Francisco bay area, Los Angeles basin, San Diego region, and the Fresno-Bakersfield areas. Processes and mechanisms that will be quantified and modeled include regional climate forcing, urban heat and cool islands, on-shore warming, venting and cooling, urban climate archipelago effects, land-use effects, anthropogenic heating, and the roles of surface physical properties such as albedo, soil moisture, roughness, and urban geometry. Peculiar conditions, such as periods of coastal fog, will be separated from others in the analysis.

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These characterizations will be based on the latest highly-urbanized atmospheric modeling approaches, supplemented by analysis of observational weather data. Detailed statistical correlations and Classification and Regression Tree (CART) analysis will be undertaken, focusing on summertime conditions, and transfer functions will be developed to be incorporated into forecasting models used by the Energy Commission and electric utilities. Intra-urban variability will be characterized in a variety of ways including, as departures from the regional means or correlations with forecast-point locations (meteorological stations used by the Energy Commission and the utilities), or other specific points of relevance to be identified in consultation with the Energy Commission. A variable of most interest, summertime hourly air temperature, will be related via CART to a number of meteorological predictors at the micro and regional scales.

The modeling and observational-data analysis will be performed for 1) present conditions (last 2-5 years), 2) future climate change scenarios (with downscaled meteorology from global climate models), and 3) scenarios of future changes in urban land use and land cover. Results will be provided for at least 3 (or less if approved by CAM in writing) urban areas in California, such as the San Francisco bay area, Los Angeles basin, and Fresno-Bakersfield areas to provide a statewide representation.

C. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to:

- Develop a methodology to incorporate urban effects in probabilistic short-term, seasonal and decadal forecasts used by the Energy Commission and the utilities.
- Characterize and quantify both present and future intra-urban variability in climate, focusing on the summer season.
- Develop statistical correlations and transfer functions that merge this information with probabilistic forecasts used by the Energy Commission and utilities. The transfer functions relate intra-urban climate to probabilistic point forecasts (meteorological stations) or as departures from regional means.
- Quantify the benefits that will result from the inclusion of urban effects and intra-urban climate variability into probabilistic forecasts.
- Develop a decision-support tool based on integration of model results with information generated in the project and instructions on use and application of the transfer functions developed in the study. A graphical interface, e.g., Geographic Information System (GIS) or Google Earth, may also be a component of the decision-support tool.

Ratepayer Benefits:² This Agreement will result in the ratepayer benefits of furthering the electric-system reliability, lower costs, and increased safety by reducing uncertainty in seasonal and decadal probabilistic weather forecasts, as well as short-term forecasts used by the Energy Commission and utilities for the electric system. This study will improve the characterization and

² California Public Resources Code, Section 25711.5(a) requires projects funded by the Electric Program Investment Charge (EPIC) to result in ratepayer benefits. The California Public Utilities Commission, which established the EPIC in 2011, defines ratepayer benefits as greater reliability, lower costs, and increased safety (See CPUC "Phase 2" Decision 12-05-037 at page 19, May 24, 2012, http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/167664.PDF).

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quantification of intra-urban climate variability to enhance the regional coarse-scale forecasts. An uncertainty (or error) of 1°C in forecasting peaking temperatures is estimated to be equivalent to ~1 gigawatt of power in the California Independent System Operator (CAISO) service territory. As such, the ratepayer benefits of improving the intra-urban climate representation, which is expected to be larger than 0.5°C system-wide, will be significant.

Improved characterization and quantification of intra-urban climate variations, especially during the summer season, is critical for assessing the electric-system's anticipated load during current conditions, as well as several decades into the future when both climate and land use change over time. It will also allow for a better assessment of load and demand under various weather conditions, which will translate into more optimized generation and allocation of resources, thus a more stable electricity system. Savings from these enhancements will be passed back to the ratepayers. Finally, a more optimized grid performance can also help control emissions of carbon dioxide (CO₂) and ozone precursors, thus also improving air quality, environmental conditions, and public health.

Technological Advancement and Breakthroughs:³ This Agreement will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by adding fine-resolution, intra-urban climate detail to coarse-scale, regional-level probabilistic or deterministic forecasting thus allowing for more accurate, area-specific characterizations and forecasts for the electricity system and better apportionment of electricity generation. Reducing uncertainties in weather forecasts in turn can help save energy both on the short and long terms.

The project will generate knowledge, data, and techniques to account for significant intra-urban variations in climate in probabilistic forecasting in a manner that facilitates Energy Commission seasonal and decadal planning and for grid operation by utilities. The intra-urban variations, focusing on summer conditions, will be characterized via several metrics including instantaneous values, ranges, cumulative indexes, thresholds, and probability distribution functions. These metrics will further be weighted by both population and built-up densities to enhance the characterization of spatiotemporal variations in demand. This will help render the system's operation more efficient.

Agreement Objectives

The objectives of this Agreement are to:

- Perform analysis of observational urban weather data from existing monitor networks in California for the last 2-5 years.
- Develop current-conditions model input, i.e., current surface physical properties, land use/land cover, and meteorological initial and boundary conditions.
- Develop future years model-input land use/land cover scenarios for the years 2020, 2030, and 2050.
- Develop future-year model-input climate-change scenarios for years 2020, 2030, and 2050 by dynamically-downscaling global climate models.

³ California Public Resources Code, Section 25711.5(a) also requires EPIC-funded projects to lead to technological advancement and breakthroughs to overcome barriers that prevent the achievement of the state's statutory and energy goals.

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- Perform atmospheric modeling of present-day conditions and scenarios (future climate, future land use, and combinations thereof) for the years 2020, 2030, and 2050.
- Evaluate the present-day intra-urban climate variabilities and their changes in the future, with changes in climate and/or land use.
- Synthesize observed and modeled intra-urban climate variabilities for present and future conditions through development of statistical correlations and classification and regression tree analysis.
- Develop transfer functions of intra-urban variations in climate (focusing on temperature and summer seasons) to supplement the probabilistic forecast for the electricity system
- Develop GIS or Google Earth mapping and an initial decision-support tool for the Energy Commission and utilities planning.

III. TASK 1 GENERAL PROJECT TASKS

PRODUCTS

Subtask 1.1 Products

The goal of this subtask is to establish the requirements for submitting project products (e.g., reports, summaries, plans, and presentation materials). Unless otherwise specified by the Commission Agreement Manager (CAM), the Recipient must deliver products as required below by the dates listed in the **Project Schedule (Part V)**. Products that require a draft version are indicated by marking “**(draft and final)**” after the product name in the “Products” section of the task/subtask. If “(draft and final)” does not appear after the product name, only a final version of the product is required. With respect to due dates within this Scope of Work, “**days**” means working days.

The Recipient shall:

The Recipient shall:

For products that require a draft version, including the Final Report Outline and Final Report

- Submit all draft products to the CAM for review and comment in accordance with the Project Schedule (Part V). The CAM will provide written comments to the Recipient on the draft product within 15 days of receipt, unless otherwise specified in the task/subtask for which the product is required.
- Consider incorporating all CAM comments into the final product. If the Recipient disagrees with any comment, provide a written response explaining why the comment was not incorporated into the final product.
- Submit the revised product and responses to comments within 10 days of notice by the CAM, unless the CAM specifies a longer time period, or approves a request for additional time.

For products that require a final version only

- Submit the product to the CAM for acceptance. The CAM may request minor revisions or explanations prior to acceptance.

For all products

- Submit all data and documents required as products in accordance with the following:

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Instructions for Submitting Electronic Files and Developing Software:

- **Electronic File Format**
 - Submit all data and documents required as products under this Agreement in an electronic file format that is fully editable and compatible with the Energy Commission's software and Microsoft (MS)-operating computing platforms, or with any other format approved by the CAM. Deliver an electronic copy of the full text of any Agreement data and documents in a format specified by the CAM, such as memory stick or CD-ROM.

The following describes the accepted formats for electronic data and documents provided to the Energy Commission as products under this Agreement, and establishes the software versions that will be required to review and approve all software products:

- Data sets will be in MS Access or MS Excel file format (version 2007 or later), or any other format approved by the CAM.
 - Text documents will be in MS Word file format, version 2007 or later.
 - Documents intended for public distribution will be in PDF file format.
 - The Recipient must also provide the native Microsoft file format.
 - Project management documents will be in Microsoft Project file format, version 2007 or later.
-
- **Software Application Development**

Use the following standard Application Architecture components in compatible versions for any software application development required by this Agreement (e.g., databases, models, modeling tools), unless the CAM approves other software applications such as open source programs:

 - Microsoft ASP.NET framework (version 3.5 and up). Recommend 4.0.
 - Microsoft Internet Information Services (IIS), (version 6 and up) Recommend 7.5.
 - Visual Studio.NET (version 2008 and up). Recommend 2010.
 - C# Programming Language with Presentation (UI), Business Object and Data Layers.
 - SQL (Structured Query Language).
 - Microsoft SQL Server 2008, Stored Procedures. Recommend 2008 R2.
 - Microsoft SQL Reporting Services. Recommend 2008 R2.
 - XML (external interfaces).

Any exceptions to the Electronic File Format requirements above must be approved in writing by the CAM. The CAM will consult with the Energy Commission's Information Technology Services Branch to determine whether the exceptions are allowable.

MEETINGS

Subtask 1.2 Kick-off Meeting

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

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The Recipient shall:

- Attend a “Kick-off” meeting with the CAM, the Commission Agreement Officer (CAO), and any other Energy Commission staff relevant to the Agreement. The Recipient will bring its Project Manager and any other individuals designated by the CAM to this meeting. The administrative and technical aspects of the Agreement will be discussed at the meeting. Prior to the meeting, the CAM will provide an agenda to all potential meeting participants. The meeting may take place in person or by electronic conferencing (e.g., WebEx), with approval of the CAM.

The administrative portion of the meeting will include discussion of the following:

- Terms and conditions of the Agreement;
- Administrative products (subtask 1.1);
- CPR meetings (subtask 1.3);
- Match fund documentation (subtask 1.7);
- Permit documentation (subtask 1.8);
- Subcontracts (subtask 1.9); and
- Any other relevant topics.

The technical portion of the meeting will include discussion of the following:

- The CAM’s expectations for accomplishing tasks described in the Scope of Work;
 - An updated Project Schedule;
 - Technical products (subtask 1.1);
 - Progress reports and invoices (subtask 1.5);
 - Final Report (subtask 1.6);
 - Technical Advisory Committee meetings (subtasks 1.10 and 1.11); and
 - Any other relevant topics.
- Provide an *Updated Project Schedule, List of Match Funds, and List of Permits*, as needed to reflect any changes in the documents.

The CAM shall:

- Designate the date and location of the meeting.
- Send the Recipient a *Kick-off Meeting Agenda*.

Recipient Products:

- Updated Project Schedule *(if applicable)*
- Updated List of Match Funds *(if applicable)*
- Updated List of Permits *(if applicable)*

CAM Product:

- Kick-off Meeting Agenda

Subtask 1.3 Critical Project Review (CPR) Meetings

The goal of this subtask is to determine if the project should continue to receive Energy Commission funding, and if so whether any modifications must be made to the tasks, products, schedule, or budget. CPR meetings provide the opportunity for frank discussions between the Energy Commission and the Recipient. As determined by the CAM, discussions may include

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project status, challenges, successes, advisory group findings and recommendations, final report preparation, and progress on technical transfer and production readiness activities (if applicable). Participants will include the CAM and the Recipient, and may include the CAO and any other individuals selected by the CAM to provide support to the Energy Commission.

CPR meetings generally take place at key, predetermined points in the Agreement, as determined by the CAM and as shown in the Task List on page 1 of this Exhibit. However, the CAM may schedule additional CPR meetings as necessary. The budget will be reallocated to cover the additional costs borne by the Recipient, but the overall Agreement amount will not increase. CPR meetings generally take place at the Energy Commission, but they may take place at another location, or may be conducted via electronic conferencing (e.g., WebEx) as determined by the CAM.

The Recipient shall:

- Prepare a *CPR Report* for each CPR meeting that: (1) discusses the progress of the Agreement toward achieving its goals and objectives; and (2) includes recommendations and conclusions regarding continued work on the project.
- Submit the CPR Report along with any other *Task Products* that correspond to the technical task for which the CPR meeting is required (i.e., if a CPR meeting is required for Task 2, submit the Task 2 products along with the CPR Report).
- Attend the CPR meeting.
- Present the CPR Report and any other required information at each CPR meeting.

The CAM shall:

- Determine the location, date, and time of each CPR meeting with the Recipient's input.
- Send the Recipient a *CPR Agenda* and a *List of Expected CPR Participants* in advance of the CPR meeting. If applicable, the agenda will include a discussion of match funding and permits.
- Conduct and make a record of each CPR meeting. Provide the Recipient with a *Schedule for Providing a Progress Determination* on continuation of the project.
- Determine whether to continue the project, and if so whether modifications are needed to the tasks, schedule, products, or budget for the remainder of the Agreement. If the CAM concludes that satisfactory progress is not being made, this conclusion will be referred to the Deputy Director of the Energy Research and Development Division.
- Provide the Recipient with a *Progress Determination* on continuation of the project, in accordance with the schedule. The Progress Determination may include a requirement that the Recipient revise one or more products.

Recipient Products:

- CPR Report(s)
- Task Products (draft and/or final as specified in the task)

CAM Products:

- CPR Agenda
- List of Expected CPR Participants
- Schedule for Providing a Progress Determination
- Progress Determination

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Subtask 1.4 Final Meeting

The goal of this subtask is to complete the closeout of this Agreement.

The Recipient shall:

- Meet with Energy Commission staff to present project findings, conclusions, and recommendations. The final meeting must be completed during the closeout of this Agreement. This meeting will be attended by the Recipient and CAM, at a minimum. The meeting may occur in person or by electronic conferencing (e.g., WebEx), with approval of the CAM.

The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be divided into two separate meetings at the CAM's discretion.

- The technical portion of the meeting will involve the presentation of findings, conclusions, and recommended next steps (if any) for the Agreement. The CAM will determine the appropriate meeting participants.
- The administrative portion of the meeting will involve a discussion with the CAM and the CAO of the following Agreement closeout items:
 - Disposition of any state-owned equipment.
 - Need to file a Uniform Commercial Code Financing Statement (Form UCC-1) regarding the Energy Commission's interest in patented technology.
 - The Energy Commission's request for specific "generated" data (not already provided in Agreement products).
 - Need to document the Recipient's disclosure of "subject inventions" developed under the Agreement.
 - "Surviving" Agreement provisions such as repayment provisions and confidential products.
 - Final invoicing and release of retention.
- Prepare a *Final Meeting Agreement Summary* that documents any agreement made between the Recipient and Commission staff during the meeting.
- Prepare a *Schedule for Completing Agreement Closeout Activities*.
- Provide *All Draft and Final Written Products* on a CD-ROM or USB memory stick, organized by the tasks in the Agreement.

Products:

- Final Meeting Agreement Summary (*if applicable*)
- Schedule for Completing Agreement Closeout Activities
- All Draft and Final Written Products

REPORTS AND INVOICES

Subtask 1.5 Progress Reports and Invoices

The goals of this subtask are to: (1) periodically verify that satisfactory and continued progress is made towards achieving the project objectives of this Agreement; and (2) ensure that invoices contain all required information and are submitted in the appropriate format.

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The Recipient shall:

- Submit a monthly *Progress Report* to the CAM. Each progress report must:
 - Summarize progress made on all Agreement activities as specified in the scope of work for the preceding month, including accomplishments, problems, milestones, products, schedule, fiscal status, and an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. See the Progress Report Format Attachment for the recommended specifications.
- Submit a monthly or quarterly *Invoice* that follows the instructions in the “Payment of Funds” section of the terms and conditions, including a financial report on Match Fund and in-state expenditures.

Products:

- Progress Reports
- Invoices

Subtask 1.6 Final Report

The goal of this subtask is to prepare a comprehensive Final Report that describes the original purpose, approach, results, and conclusions of the work performed under this Agreement. The CAM will review and approve the Final Report, which will be due at least **two months** before the Agreement end date. When creating the Final Report Outline and the Final Report, the Recipient must use a Style Manual provided by the CAM.

Subtask 1.6.1 Final Report Outline

The Recipient shall:

- Prepare a *Final Report Outline* in accordance with the *Style Manual* provided by the CAM. (See Task 1.1 for requirements for draft and final products.)

Recipient Products:

- Final Report Outline (draft and final)

CAM Products:

- Style Manual
- Comments on Draft Final Report Outline
- Approval of Final Report Outline

Subtask 1.6.2 Final Report

The Recipient shall:

- Prepare a *Final Report* for this Agreement in accordance with the approved Final Report Outline, Style Manual, and Final Report Template provided by the CAM with the following considerations:
 - Ensure that the report includes the following items, in the following order:
 - Cover page (**required**)
 - Credits page on the reverse side of cover with legal disclaimer (**required**)
 - Acknowledgements page (optional)
 - Preface (**required**)

Exhibit A Scope of Work

- Abstract, keywords, and citation page (**required**)
- Table of Contents (**required**, followed by List of Figures and List of Tables, if needed)
- Executive summary (**required**)
- Body of the report (**required**)
- References (if applicable)
- Glossary/Acronyms (If more than 10 acronyms or abbreviations are used, it is required.)
- Bibliography (if applicable)
- Appendices (if applicable) (Create a separate volume if very large.)
- Attachments (if applicable)
- Ensure that the document is written in the third person.
- Ensure that the Executive Summary is understandable to the lay public.
 - Briefly summarize the completed work. Succinctly describe the project results and whether or not the project goals were accomplished.
 - Identify which specific ratepayers can benefit from the project results and how they can achieve the benefits.
 - If it's necessary to use a technical term in the Executive Summary, provide a brief definition or explanation when the technical term is first used.
- Follow the Style Guide format requirements for headings, figures/tables, citations, and acronyms/abbreviations.
- Ensure that the document omits subjective comments and opinions. However, recommendations in the conclusion of the report are allowed.
- Include a brief description of the project results in the Abstract.
- Submit a draft of the report to the CAM for review and comment. The CAM will provide written comments to the Recipient on the draft product within 15 days of receipt
- Consider incorporating all CAM comments into the Final Report. If the Recipient disagrees with any comment, provide a written response explaining why the comment was not incorporated into the final product
- Submit the revised Final Report and responses to comments within 10 days of notice by the CAM, unless the CAM specifies a longer time period or approves a request for additional time.
- Submit one bound copy of the *Final Report* to the CAM along with *Written Responses to Comments on the Draft Final Report*.

Products:

- Final Report (draft and final)
- Written Responses to Comments on the Draft Final Report

CAM Products:

- Written Comments on the Draft Final Report

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MATCH FUNDS, PERMITS, AND SUBCONTRACTS

Subtask 1.7 Match Funds

The goal of this subtask is to ensure that the Recipient obtains any match funds planned for this Agreement and applies them to the Agreement during the Agreement term.

While the costs to obtain and document match funds are not reimbursable under this Agreement, the Recipient may spend match funds for this task. The Recipient may only spend match funds during the Agreement term, either concurrently or prior to the use of Energy Commission funds. Match funds must be identified in writing, and the Recipient must obtain any associated commitments before incurring any costs for which the Recipient will request reimbursement.

The Recipient shall:

- Prepare a *Match Funds Status Letter* that documents the match funds committed to this Agreement. 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 this in the letter.

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 cash match funds, their source(s) (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied.
 - The amount of each in-kind contribution, a description of the contribution type (e.g., property, services), the documented market or book value, the 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 Recipient must identify its owner and provide a contact name, address, telephone number, and the address where the property is located.
- A copy of a letter of commitment from an authorized representative of each source of match funding that the funds or contributions have been secured.
- At the Kick-off meeting, discuss match funds and the impact on the project if they are significantly reduced or not obtained as committed. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.
- Provide a *Supplemental Match Funds Notification Letter* to the CAM of receipt of additional match funds.
- Provide a *Match Funds Reduction Notification Letter* to the CAM if existing match funds are reduced during the course of the Agreement. Reduction of match funds may trigger a CPR meeting.

Products:

- Match Funds Status Letter
- Supplemental Match Funds Notification Letter *(if applicable)*
- Match Funds Reduction Notification Letter *(if applicable)*

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Subtask 1.8 Permits

The goal of this subtask 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 not reimbursable under this Agreement, with the exception of costs incurred by University of California recipients. Permits must be identified and obtained before the Recipient may incur any costs related to the use of the permit(s) for which the Recipient will request reimbursement.

The Recipient shall:

- Prepare a *Permit Status Letter* that documents the permits required to conduct this Agreement. If no permits are required at the start of this Agreement, then state this in the letter. If permits will be required during the course of the Agreement, provide in the letter:
 - A list of the permits that identifies: (1) the type of permit; and (2) the name, address, and telephone number of the permitting jurisdictions or lead agencies.
 - The schedule the Recipient will follow in applying for and obtaining the permits.

The list of permits and the schedule for obtaining them will be discussed at the Kick-off meeting (subtask 1.2), and a timetable for submitting the updated list, schedule, and copies of the permits will be developed. The impact on the project 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 progress reports and will be a topic at CPR meetings.

- If during the course of the Agreement additional permits become necessary, then provide the CAM with an *Updated List of Permits* (including the appropriate information on each permit) and an *Updated Schedule for Acquiring Permits*.
- Send the CAM a *Copy of Each Approved Permit*.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the CAM within 5 days. Either of these events may trigger a CPR meeting.

Products:

- Permit Status Letter
- Updated List of Permits (*if applicable*)
- Updated Schedule for Acquiring Permits (*if applicable*)
- Copy of Each Approved Permit (*if applicable*)

Subtask 1.9 Subcontracts

The goals of this subtask are to: (1) procure subcontracts required to carry out the tasks under this Agreement; and (2) ensure that the subcontracts are consistent with the terms and conditions of this Agreement.

The Recipient shall:

- Manage and coordinate subcontractor activities in accordance with the requirements of this Agreement.
- Incorporate this Agreement by reference into each subcontract.
- Include any required Energy Commission flow-down provisions in each subcontract, in addition to a statement that the terms of this Agreement will prevail if they conflict with the subcontract terms.
- If required by the CAM, submit a draft of each *Subcontract* required to conduct the work under this Agreement.

Exhibit A Scope of Work

- Submit a final copy of the executed subcontract.
- Notify and receive written approval from the CAM prior to adding any new subcontractors (see the discussion of subcontractor additions in the terms and conditions).

Products:

- Subcontracts (*draft if required by the CAM*)

TECHNICAL ADVISORY COMMITTEE

Subtask 1.10 Technical Advisory Committee (TAC)

The goal of this subtask is to create an advisory committee for this Agreement. The TAC should be composed of diverse professionals. The composition will vary depending on interest, availability, and need. TAC members will serve at the CAM's discretion. The purpose of the TAC is to:

- Provide guidance in project direction. The guidance may include scope and methodologies, timing, and coordination with other projects. The guidance may be based on:
 - Technical area expertise;
 - Knowledge of market applications; or
 - Linkages between the agreement work and other past, present, or future projects (both public and private sectors) that TAC members are aware of in a particular area.
- Review products and provide recommendations for needed product adjustments, refinements, or enhancements.
- Evaluate the tangible benefits of the project to the state of California, and provide recommendations as needed to enhance the benefits.
- Provide recommendations regarding information dissemination, market pathways, or commercialization strategies relevant to the project products.

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

- Researchers knowledgeable about the project subject matter;
- Members of trades that 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 the project;
- U.S. Department of Energy research managers, or experts from other federal or state agencies relevant to the project;
- Public interest environmental groups;
- Utility representatives;
- Air district staff; and
- Members of relevant technical society committees.

The Recipient shall:

- Prepare a *List of Potential TAC Members* that includes the names, companies, physical and electronic addresses, and phone numbers of potential members. The list will be

Exhibit A Scope of Work

discussed at the Kick-off meeting, and a schedule for recruiting members and holding the first TAC meeting will be developed.

- Recruit TAC members. Ensure that each individual understands member obligations and the TAC meeting schedule developed in subtask 1.11.
- Prepare a *List of TAC Members* once all TAC members have committed to serving on the TAC.
- Submit *Documentation of TAC Member Commitment* (such as Letters of Acceptance) from each TAC member.

Products:

- List of Potential TAC Members
- List of TAC Members
- Documentation of TAC Member Commitment

Subtask 1.11 TAC Meetings

The goal of this subtask is for the TAC to provide strategic guidance for the project by participating in regular meetings, which may be held via teleconference.

The Recipient shall:

- Discuss the TAC meeting schedule with the CAM at the Kick-off meeting. Determine the number and location of meetings (in-person and via teleconference) in consultation with the CAM.
- Prepare a *TAC Meeting Schedule* that will be presented to the TAC members during recruiting. Revise the schedule after the first TAC meeting to incorporate meeting comments.
- Prepare a *TAC Meeting Agenda* and *TAC Meeting Back-up Materials* for each TAC meeting.
- Organize and lead TAC meetings in accordance with the TAC Meeting Schedule. Changes to the schedule must be pre-approved in writing by the CAM.
- Prepare *TAC Meeting Summaries* that include any recommended resolutions of major TAC issues.

Products:

- TAC Meeting Schedule (draft and final)
- TAC Meeting Agendas (draft and final)
- TAC Meeting Back-up Materials
- TAC Meeting Summaries

Exhibit A Scope of Work

IV. TECHNICAL TASKS

*Products that require a draft version are indicated by marking “(draft and final)” after the product name in the “Products” section of the task/subtask. If “(draft and final)” does not appear after the product name, only a final version of the product is required. **Subtask 1.1 (Products)** describes the procedure for submitting products to the CAM.*

TASK 2 Analysis of Observational Weather Data

The goal of this task is to analyze observational urban meteorological data to supplement modeling results in characterizing intra-urban climate variability under current conditions and prepare the data for use in the simulations.

The Recipient shall:

- Obtain and, if necessary, acquire observational weather data from existing monitor networks in regions selected for analysis, including San Francisco bay area, Los Angeles basin, San Diego region, and the Fresno-Bakersfield areas. The main data sources will be National Oceanic and Atmospheric Administration (NOAA) and National Climatic Data Center (NCDC). Additional observational data may also be obtained.
- Perform analysis of hourly observational data from the last 2-5 years focusing on summer seasons and evaluate their usefulness in supplementing model results for characterizing intra-urban climate variability.
- Analyze variability in urban climates focusing on air temperature and generate representative metrics and statistics such as minima, means, and maxima, time series, cumulative indexes such as cooling and heating degree-hours over the selected periods and thresholds.
- Identify characteristics of intra-urban climate features on multiple temporal and spatial scale, including heat islands, cool islands, flow patterns, on-shore warming and archipelago effects.
- Prepare and recast the observational data for use in Task 3 in 1) four-dimensional data assimilation (FDDA) in the model and 2) in model performance evaluation.
- Prepare an *Analysis of Observational Weather Data Report* that includes the following:
 - A summary and characterization of weather data sources and monitor locations throughout the urban areas that are selected for analysis in this project
 - A summary of results from observational meteorology analysis and intra-urban variations in micrometeorology, focusing on air temperature during summer
 - A translation of observed data into useful metrics for the electricity system, such as maxima, minima, time series, thresholds, and cumulative metrics including cooling and heat degree-hours
 - Preparation of observational data for use in data assimilation in the meteorological model and in model performance evaluation in Task 3.

Products:

- Analysis of Observational Weather Data Report (Draft and Final)

TASK 3 Urban Atmospheric Modeling

The goal of this task is to perform fine-resolution, highly-urbanized atmospheric modeling of 1) present conditions, 2) future land-use scenarios, and 3) future climate scenarios.

Exhibit A Scope of Work

The Recipient shall:

- Configure the Weather Research and Forecasting model (WRF) and select suitable parameterizations (including highly-urbanized modules and recipient's own model updates) per specific requirements in this application.
- Modify, update, customize, and test the model's parameterizations as needed in order to account better for urban-scale atmospheric processes within the urban canopy and boundary layers and their interactions with urban physical and morphometric properties.
- Develop meteorological model input for present-day conditions (from reanalysis) for the summer seasons of the last 2-5 years. In addition, develop observational FDDA input based on data developed in Task 2.
- Develop surface physical-properties input for present conditions, including urban morphometric characterizations.
- Develop present-day land-use/land-cover characterizations for derivation of surface-characteristics input to the meteorological models.
- Carry out atmospheric modeling of present-day conditions (last 2-5 years) focusing on the selected urban areas and summer seasons.
- Using observational data from Task 2 as well as other appropriate data sources, carry out quantitative model performance evaluation per modeling-community recommended benchmarks.
- Define point-forecast locations (meteorological stations used by Energy Commission and utilities in probabilistic forecasting), regional means, or time-varying reference points for computation of intra-urban variations in climate, with focus on air temperature.
- Develop future-year land-use/land-cover characterizations and input to meteorological models based on projections of land-use changes in California for years 2020, 2030, and 2050.
- Develop future-climate input to meteorological model by dynamically downscaling output from global climate models for several future years including years 2020, 2030, and 2050, or beyond (or other years deemed of interest by the Energy Commission and the project advisory committee). This will also focus on summer conditions.
- As a test, downscale output from the Global Forecast Model (GFS) to evaluate the short-term predictive values of transfer functions to be developed in Task 4.
- Carry out simulations for 1) future-year land-use/land-cover, 2) future-year climates, and 3) combinations of both future land-use/land-cover and climate scenarios, focusing on summer.
- Re-compute future-year intra-urban climate variations relative to reference points identified in task above, with focus on air temperature.
- Evaluate whether future-year intra-urban climate variations differ from those under current conditions and, if different, quantify the extent of such differences; and
- Prepare an *Urban Atmospheric Modeling Report* that includes the following:
 - Summary and discussion of results from urban-scale meteorological and micrometeorological simulations, with a focus on temperature-related results for present and future land-use/land-cover and climate scenarios.
 - Description of temperature-related derived metrics, such as maxima/minima, time series, and cumulative indices including cooling/heating degree-hours and variations thereof, as well as probability distribution functions.
 - A discussion of modeled features of relevance to urban climate variability including urban heat and cool islands, flow patterns, coupling among different urban areas, urban archipelagos, and heat-transport effects; and

Exhibit A Scope of Work

- Correlation of modeled intra-urban variations with land-use/land-cover and urban morphometric properties.
- Prepare *CPR Report* per Subtask 1.3.
- Participate in the CPR Meeting.

Products:

- Urban Atmospheric Modeling Report (Draft and Final)
- CPR Report

TASK 4 Development of Correlations and Transfer Functions

The goal of this task is to develop the statistical correlations, carry out and integrate CART analysis, and develop transfer functions to characterize and quantify intra-urban climate variabilities in probabilistic and short-term weather forecasts for the electric system.

The Recipient shall:

- Carry out statistical analysis of both observed and modeled urban meteorology (from Tasks 2 and 3) to characterize intra-urban variability in climate with a focus on air temperature at multiple horizontal scales (including census-tract resolution) and vertical levels;
- Carry out CART analysis to develop a set of regional meteorological predictors to the fine-scale intra-urban variables, focusing on temperature;
- Characterize and correlate the intra-urban variations in temperature with regional near-surface and upper-air meteorological variables and at point-forecast locations that are typically used by Energy Commission and the utilities in probabilistic forecasting;
- Develop transfer functions and PDF based on the statistical and CART analysis tasks above;
- Evaluate the changes in intra-urban variability in future conditions of LULC and climate relative to current conditions;
- Develop a GIS or Google Earth decision-support tool for use by Energy Commission and the utilities and, if appropriate, incorporate the relevant results into CalEnviroScreen 2.0 and/or the CalADAPT tools for further use in planning, e.g., by Energy Commission; and
- Prepare a *Development of Correlations and Transfer Functions Report* that includes the following:
 - Summary of results from detailed statistical and CART analysis
 - Description of the development of transfer functions
 - Description of data dissemination in Google Earth or GIS

Products:

- Development of Correlations and Transfer Functions Report (Draft and Final)
- GIS-based or Google Earth-based mappings, information, and decision-support tool

Exhibit A Scope of Work

TASK 5 Evaluation of Project Benefits

The goal of this task is to report the benefits resulting from this project.

The Recipient shall:

- Complete three Project Benefits Questionnaires that correspond to three main intervals in the Agreement: (1) *Kick-off Meeting Benefits Questionnaire*; (2) *Mid-term Benefits Questionnaire*; and (3) *Final Meeting Benefits Questionnaire*.
- Provide all key assumptions used to estimate projected benefits, including targeted market sector (e.g., population and geographic location), projected market penetration, baseline and projected energy use and cost, operating conditions, and emission reduction calculations. Examples of information that may be requested in the questionnaires include:
 - For Product Development Projects and Project Demonstrations:
 - Published documents, including date, title, and periodical name.
 - Estimated or actual energy and cost savings, and estimated statewide energy savings once market potential has been realized. Identify all assumptions used in the estimates.
 - Greenhouse gas and criteria emissions reductions.
 - Other non-energy benefits such as reliability, public safety, lower operational cost, environmental improvement, indoor environmental quality, and societal benefits.
 - Data on potential job creation, market potential, economic development, and increased state revenue as a result of the project.
 - A discussion of project product downloads from websites, and publications in technical journals.
 - A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
 - Additional Information for Product Development Projects:
 - Outcome of product development efforts, such copyrights and license agreements.
 - Units sold or projected to be sold in California and outside of California.
 - Total annual sales or projected annual sales (in dollars) of products developed under the Agreement.
 - Investment dollars/follow-on private funding as a result of Energy Commission funding.
 - Patent numbers and applications, along with dates and brief descriptions.
 - Additional Information for Product Demonstrations:
 - Outcome of demonstrations and status of technology.
 - Number of similar installations.
 - Jobs created/retained as a result of the Agreement.
 - For Information/Tools and Other Research Studies:
 - Outcome of project.
 - Published documents, including date, title, and periodical name.

Exhibit A Scope of Work

- A discussion of policy development. State if the project has been cited in government policy publications or technical journals, or has been used to inform regulatory bodies.
- The number of website downloads.
- An estimate of how the project information has affected energy use and cost, or have resulted in other non-energy benefits.
- An estimate of energy and non-energy benefits.
- Data on potential job creation, market potential, economic development, and increased state revenue as a result of project.
- A discussion of project product downloads from websites, and publications in technical journals.
- A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
- Respond to CAM questions regarding responses to the questionnaires.

The Energy Commission may send the Recipient similar questionnaires after the Agreement term ends. Responses to these questionnaires will be voluntary.

Products:

- Kick-off Meeting Benefits Questionnaire
- Mid-term Benefits Questionnaire
- Final Meeting Benefits Questionnaire

TASK 6 Technology/Knowledge Transfer Activities

The goal of this task is to develop a plan to make the knowledge gained, experimental results, and lessons learned available to the public and key decision makers.

The Recipient shall:

- Prepare an *Initial Fact Sheet* at start of the project that describes the project. Use the format provided by the CAM.
- Prepare a *Final Project Fact Sheet* at the project's conclusion that discusses results. Use the format provided by the CAM.
- Prepare a *Technology/Knowledge Transfer Plan* that includes:
 - An explanation of how the knowledge gained from the project will be made available to the public, including the targeted market sector and potential outreach to end users, utilities, regulatory agencies, and others.
 - A description of the intended use(s) for and users of the project results.
 - Published documents, including date, title, and periodical name.
 - Copies of documents, fact sheets, journal articles, press releases, and other documents prepared for public dissemination. These documents must include the Legal Notice required in the terms and conditions. Indicate where and when the documents were disseminated.
 - A discussion of policy development. State if project has been or will be cited in government policy publications, or used to inform regulatory bodies.
 - The number of website downloads or public requests for project results.
 - Additional areas as determined by the CAM.

Exhibit A Scope of Work

- Conduct technology transfer activities in accordance with the Technology/Knowledge Transfer Plan. These activities will be reported in the Progress Reports.
- When directed by the CAM, develop *Presentation Materials* for an Energy Commission-sponsored conference/workshop(s) on the project.
- When directed by the CAM, participate in annual EPIC symposium sponsored by the California Energy Commission.
- Provide at least (6) six *High Quality Digital Photographs* (minimum resolution of 1300x500 pixels in landscape ratio) of pre and post technology installation at the project sites or related project photographs.
- Prepare a *Technology/Knowledge Transfer Report* on technology transfer activities conducted during the project.

Products:

- Initial Fact Sheet (draft and final)
- Final Project Fact Sheet (draft and final)
- Presentation Materials (draft and final)
- High Quality Digital Photographs
- Technology/Knowledge Transfer Plan (draft and final)
- Technology/Knowledge Transfer Report (draft and final)

V. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: ALTOSTRATUS, INC.

RESOLVED, that the State Energy Resources Conservation and Development Commission (Energy Commission) adopts the staff CEQA findings contained in the Agreement or Amendment Request Form (as applicable); and

RESOLVED, that the Energy Commission approves Agreement EPC-15-070 from GFO-15-309 with Altostratus, Inc. for a \$193,326 grant to fund the development of fine-resolution characterization of intra-urban climate variability and transfer functions to enhance the probabilistic and short-term climate forecasts for the electric system; and

FURTHER BE IT RESOLVED, that the Executive Director or his/her designee shall execute the same on behalf of the Energy Commission.

CERTIFICATION

The undersigned Secretariat to the Commission does hereby certify that the foregoing is a full, true, and correct copy of a Resolution duly and regularly adopted at a meeting of the California Energy Commission held on May 17, 2016.

AYE: [List of Commissioners]

NAY: [List of Commissioners]

ABSENT: [List of Commissioners]

ABSTAIN: [List of Commissioners]

Cody Goldthrite,
Secretariat