Proposed Agreement between California Energy Commission and The Regents of the University of California, Scripps Institution of Oceanography

Title: Climate Monitoring, Analysis, and Modeling - Phase V
Amount: $1,200,000.00
Term: 30 months
Contact: Guido Franco
Committee Meeting: 2/1/2011

Funding

FY	Program	Area	Initiative	Budget	This Project	Remaining Balance	
09	Electric	EA	Global Climate Change	$4,323,000	$1,200,000	$0	0%

Recommendation

Approve this agreement with UC San Diego to investigate changing climate conditions that may affect energy generation and demand and also to develop new climate scenarios for California for $1,200,000.00. Staff recommends placing this item on the discussion agenda of the Commission Business Meeting.

Issue

Climate change will impact every sector of the state economy and the State's natural resources. The energy sector could be affected in multiple ways, ranging from increased electricity demand for cooling to reduced energy demand for residential heating. Energy infrastructure is also vulnerable to multiple climate-induced physical impacts such as sea level rise. For example, an increased frequency and magnitude of forest fires would affect the electricity transmission, and costal power plants may be affected by sea level rise.

National and international climate change research efforts are constantly producing new findings and several national research centers have started to release new global climate projections for the 21st century for next Intergovernmental Panel on Climate Change (IPCC) Assessment Report. These global climate scenarios come from substantially improved global climate change models (Earth System Models) using higher spatial and temporal resolutions than prior IPCC Assessments. As before, the national and international research products must be tailored for California to make them relevant to policy formulation in the State. In this case, the geographical resolution of the new Earth System Models are still too coarse to resolve important features in California and should not be used directly to develop adaptation plans at the local/regional levels.

Improved climate scenarios for California are a prerequisite to continue advancing climate change impacts and adaptation science in California, including impacts and adaptation assessments for the energy sector. There are several climate research issues of high relevance to the energy sector. This

paragraph illustrates a few examples of these issues. It is unclear if coastal upwelling (rise of cold, often nutrient-rich waters from the ocean depths to the surface) will increase or decrease under a changing climate which would decrease or increase electricity demand in the summer. Another issue is that climate impacts in California are affected strongly by the hydrological conditions, including rain, snow, run-off, and soil moisture of the land surface. These conditions are closely tied to water resources, including hydropower, and also modulate surface temperatures and thus influence the demand for electricity. However, hydrologic models used to estimate these impacts have limitations that may prove critical for impact assessments, such as the assumption that snow melting is a function of ambient air temperature only. This assumption works well for historical conditions, but since temperature is used as a proxy for solar radiation this simplification may not work well under future conditions because temperatures may go up with or without a concomitant change in solar radiation. The start and duration of the snow melting period is very important to estimate potential impacts to hydropower generation.

Background

Since 2003, the Energy Commission's Climate Change Center at the Scripps Institution of Oceanography has produced policy-relevant research products that have been extremely valuable in informing policy in California. A case in point, the 2006 and 2009 reports from the California Climate Action Team made use of the climate scenarios developed by the Center at Scripps. More recently, the Center made the case that reducing greenhouse gas emissions will not be enough and that some impacts are unavoidable. This finding was a contributing factor to Executive Order S-13-08 that mandated the preparation of adaptation strategies for California under the leadership of the Natural Resources Agency.

Phase V of the activities of the Center at Scripps will continue supporting core research activities that will be used for future reports to the Governor and the Legislature and support adaptation planning by local, regional, and state entities.

Proposed Work

Phase V will include the following activities:

- Climate Monitoring - Scripps will improve the measurement of climate conditions in California by adding snow, soil moisture, and radiation sensors to existing meteorological stations installed with prior PIER funding. Mountain snowpack is a crucial, natural water reservoir for California. An ample spring snowpack is not only an important water resource, but it also provides hydropower and is thought to help retard large summer forest fires. Solar radiation is a key driver of spring snow melt and is also a fundamental component that affects natural ecosystems and agriculture. Soil moisture is tied to snow melt, runoff and ecosystem status. Adding radiation, snow, and soil moisture sensors to stations along mountain and river transects will provide an important element in verifying and understanding hydrological model performance, and more generally to interpret and predict effects of climate variation and changes on processes that drive water and energy resources in the state.

- Data Archive - Scripps will continue archiving historical climate data for California and making the data sets available to the research community, governmental agencies, utilities, and other entities. Scripps will also support the preparation of climate trend analyses reported in multiple publications such as the Indicators of Climate Change in California. The researchers will contribute to the dissemination

of climate trend analyses for California via the Cal-Adapt website that will be released in April or May of this year.

- New climate scenarios for California - Scripps will improve the models used to downscale the results from global climate models to the California region and will develop a new set of "probabilistic" climate projections using the results from the models being released for the next IPCC Assessment Report. Some of the improvements include the estimation of solar radiation, wind, relative humidity and other parameters in the statistical downscaling models. The current statistical models only estimate temperature and precipitation and this is the main reason temperature was used to estimate snow melt in prior PIER work. The researchers will also couple a dynamic atmospheric model (similar to the models used to forecast weather events) with a regional ocean model to more closely investigate the potential role of upwelling on our climate. The "probabilistic" scenarios will be used for future impacts and adaptation studies to be submitted to the Governor and the Legislature. As in the past, most likely, these scenarios will be used for long-term resource planning by governmental agencies and private entities such as utilities.

- Coastal fog and climate change - A recent observational study by Johnstone and Dawson (2010 PNAS) presents tentative evidence of diminished coastal ground based and elevated fog. These observational results are in sharp contrast with previous indirect observational and modeling studies suggesting that climate change would disproportionately warm the interior region of California, resulting in an enhanced onshore flow and then an increase in coastal fog and upwelling. To help resolve these differences, more in-depth studies are needed by unraveling the relationships between cloud, atmospheric circulation patterns, sea surface temperatures in the Pacific Ocean, daily maximum and minimum temperatures, and other parameters. The researchers will also investigate the effect of some natural variations in climate such as the Pacific Decadal Oscillation on coastal fog. As indicated before, a new coupled regional ocean-atmosphere model will also be used to understand the processes involved.

- Investigation of potential sources of errors in hydrologic models used for climate change studies - Scripps will investigate potential sources of errors in hydrological models commonly used for climate change impacts studies. For example, the researchers will investigate the main factors that affect snow melting, including solar radiation, and improve and test hydrological models. These models provide estimates of how climate change would impact the snow pack and streamflows and therefore hydropower generation.

- Climate load forecasting scoping study - The downscaling techniques developed for the PIER program for climate change studies could also be used to further refine near-term and seasonal probabilistic forecasts. An on-going project involving major research centers around the world known as the Coupled Model Inter-comparison Project will initialize their forecast models with current conditions and generate 10-year climate outlooks. The outputs from this major global effort will be further downscaled for the California region via Scripps. These probabilistic 10-year climate projections for California could be used for the Energy Commission's 10 year energy demand forecasts. Other techniques developed by Scripps such as using sea surface temperatures in the Pacific Ocean to condition summer probabilistic forecasts several months in advance could be used for the Energy Commission's summer electricity supply and demand outlook reports. At the moment, the Energy Commission is using historical weather conditions to estimate future potential outcomes that do not take climate change into account. This practice may underestimate the probability of occurrences of events

with important energy implications such as the 2006 heat wave. Staff from the Energy Commission Demand Forecast Office was involved in the design of this study and will work very closely with the research team to ascertain the usefulness of the products developed by Scripps.

Justification and Goals

This project "[will] advance energy science or technologies of value to California citizens..." (Public Resources Code 25620.(c)), and is part of a "full range of research, development, and demonstration activities that . . . are not adequately provided for by competitive and regulated markets (Public Resources Code 25620.1.(a)); and supports California's goal to develop regional climate models designed to allow strategic planning for water availability and related planning for electricity supply per the Integrated Energy Policy Report 2005.

This project also addresses Governor's Executive Order S-3-05 that mandates the preparation of biennial climate change impacts studies. The Energy Commission is the main source of this information, provided to the Governor and the Legislature via the Climate Change Action Team. Executive Order S-13-08 and the recently adopted 2009 California Climate Adaptation Strategy identify the Energy Commission's PIER Program as the main source of scientific information on climate change research in California that is needed to develop adaptation measures.

This will be accomplished by:

- Investigating physical factors that may change energy generation and/or demand.
- Developing new climate scenarios for California.