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October 1, 2012

Dr. Robert B. Weisenmiller
Chair
California Energy Commission
Dockets Office, MS-4
Re: Docket No. 12-EPIC-01
1516 Ninth Street
Sacramento, CA 95814-5512

Dear Dr. Weisenmiller,

Thank you for this opportunity to comment on the First Triennial Investment Plan for the Electric Program Investment Charge Program.

The California Center for Climate Change (CCCC) at Scripps Institution of Oceanography at UC San Diego has developed and refined relevant and predictive climate forecasts for use by policymakers, energy companies, and utilities and their users and ratepayers for more than a decade. Coordination of studies including climate and temperature variations, weather cycles, and extreme weather events are enabling public and private sectors alike to prepare and implement strategic and tactical plans to deliver adequate and affordable energy to growing and changing demographic sub-regions.

Southern California Edison (SCE) has, in separate comments, underscored both the value and the complications associated with clean energy generation, predictive grid operations, demand side management, and health and safety. Each of these broad categories of public service relies upon timely, accurate, and scientifically demonstrable data such as that provided by the CCCC and its associate universities and research units.

For instance, among recommendations offered by SCE, the determination of regional metrics for acre-feet of "cold water" transportation and utilization would benefit tangibly from predictive water providence and availability data as the company endeavors to identify regional conservation footprints.

We also recognize the wisdom in comments by the California Electric Grid Research Group, whose recommendations address regulatory and societal mandates to reduce GHG emissions, and to develop smart grid technologies that are, we hope, measurably "more observable, controllable, and adaptable." Scripps would look forward to closer associations with both energy providers and community-based environmental advocacy organizations in these respects.

We are also impressed by forward-looking comments of the California Energy Efficiency Council with regard to the advancement of innovative energy technologies. We caution, however, that investment in zero-net energy buildings and industrial and agricultural efficiencies, particularly in view of limited public and private sector resources, should take into account the best predictive climate and weather data for a given area, including water availability and usage forecasts.

We would like to suggest the following specific changes and/or additions to the Investment Plan text:

1. We note that the discussion of short-term weather prediction for renewable energy in funding initiative S4.2 (pp. 63-64) already includes mention of UCSD as an expert on improving forecasting of short-term conditions (clouds and wind) needed for renewable, especially related to the marine layer. We recommend addition of the work NOAA's Earth System Research Laboratory's (led by Dr. Marty Ralph) successful 2-year project with DOE in improving forecasts of turbine-level winds (in the boundary layer) using hi-res numerical models and a network of wind profilers in the upper Midwestern United States.

2. In the section on offshore wind energy in funding initiative S4.4 (pp. 66-67), we recommend mentioning the value of developing buoy-mounted wind profiler technology to help with quantifying offshore wind energy potential. Consider adding the following on page 67 under Background:

> "Measurements of winds above the surface over the ocean are very rare and yet define the potential wind energy available offshore. Past developments in wind profiler technology that measures winds aloft from ground-based locations in California through NOAA's Hydrometeorology Testbed (HMT) Program suggest that such measurements could be performed offshore on a buoy. Such a sensor would also benefit prediction of storms that produce water used for hydropower and winds that can damage energy infrastructure. Combining NOAA/HMT radar expertise with Scripps Institution of Oceanography's buoy capabilities could fill this gap."

We also recommend adding on pp. 66-67 as a bullet:

> "Develop buoy-mounted meteorological radar to monitor winds aloft at turbine level to help quantify wind energy potential offshore."

3. In funding initiative S5.3 (pp. 73-75), we suggest addition of NOAA HMT, SIO, atmospheric rivers, aerosols, the California Water Service Company, or some combination of these. In each of the other subsections of Section 3, there is a place where "background" information is provided, and these often mention specific organizations and/or capabilities/projects. We attach to this letter a revised version of the text for funding initiative S5.3 with suggested changes highlighted.

4. Funding initiative S5.4, which is on extreme events and climate, could highlight aerosol impacts of clouds and precipitation and thus on hydropower. Included in our attachment to this letter are suggested revisions to this section.

The Commission's management of PIER has resulted in signal achievements in California's energy development and management strategies and in reducing its GHG footprint. It has simultaneously demonstrated to the nation that the state's public goods charge has improved both environmental and energy sector bottom lines. Scripps is confident that EPIC will augment further the state's leadership in turning energy and climate challenges into public benefits and private sector opportunities, and hopes continue to participate in these efforts as a provider of essential and fundamental climate and weather data, measurements, and predictions.

Sincerely yours,

Catherine Constable
Acting Director, Scripps Institution of Oceanography

/s/ CC: Kathleen Ritzman, Assistant Director, Scripps Institution of Oceanography
Rudy Murillo, Director, State Gov Relations, Scripps Institution of Oceanography
Dan Cayan, Research, Scripps Institution of Oceanography

Attachment: Suggested revisions to Sections S.5.3 and S.5.4 of the First Triennial Investment Plan for the Electric Program Investment Charge Program.

From pages 73-75:

S5.3 Proposed Funding Initiative: Develop Analytical Tools and Technologies to Reduce Energy Stresses on Aquatic Resources and Improve Water-Energy Management.

Issues: Water is closely intertwined with the state's electricity system. Not only is electricity used to pump, treat, and dispose of water, but water is used in electricity generation as well. The most obvious example of this is hydropower where flowing water is used to generate electricity, but water is integral to many other generating processes as well.

As California's electricity system evolves to meet the state's renewable energy and greenhouse gas emission goals, it is important to reduce electricity's demand for water given that scarce freshwater resources may be a barrier to greater penetration of certain renewable energy technologies like concentrating solar power, geothermal, and biomass.

Opportunities for construction of new hydroelectric plants are extremely limited in California. Most economically viable sites have already been taken and development of remaining suitable sites faces significant barriers. Because hydropower plays a significant role in the state's electricity system, there are significant opportunities from improved forecasting and decision support tools as well as an improved understanding of meteorological processes that affect precipitation patterns, runoff and hydropower generation.

As identified in the *2005 Integrated Energy Policy Report*, there is a need for research to reduce the effects of hydropower generation on California's aquatic ecosystems. California's inland fish populations have steeply declined, in part due to hydropower generation. As existing non-federal hydropower facilities are relicensed by the Federal Energy Regulatory Commission, there is a need for research to inform this permitting process.

Environmental concerns may also pose significant permitting issues for emerging marine renewable energy technologies such as wave energy devices or offshore wind. Wave energy devices may change near-shore sediment transport, adversely affecting near-shore benthic (sea bottom) communities. Fish are anticipated to use wave energy conversion installations as artificial habitat, so sound and electromagnetic fields from the technology may affect their behavior. Large arrays of wave energy devices may block migratory marine mammal migration routes. Offshore wind anchoring devices may also block migrating marine mammals and cause bird and bat collisions with the wind turbines. It is important that these environmental effects be assessed and, where needed, be avoided, resolved, or reduced prior to commercial deployment of these emerging technologies.

Purpose: This initiative will develop tools, technologies, and information to inform the permitting and deployment process to help improve water and energy management. For example, there is a need to improve understanding of meteorological processes to increase the ability to forecast precipitation and runoff for hydropower generation. For example NOAA's Hydrometeorology Testbed (HMT) has identified that "atmospheric rivers" represent the specific meteorological conditions that produce most of the precipitation and runoff in much of California and has explored how to improve the monitoring

and prediction of atmospheric rivers. Some of this effort is in support of California's Department of Water Resources. There is also a need to develop innovative forecasting techniques, such as for high elevation hydropower which represents about a third of in-state hydropower generating capacity. For example, the Hydrologic Research Center (HRC) has demonstrated at five low elevation multi-purpose reservoirs in Northern California the usefulness of probabilistic runoff forecasts to improve hydropower generation and water management. This initiative would support research and development related to better monitoring and forecasting of atmospheric rivers, including impacts on to high elevation hydropower projects and coordination of reservoir operations.

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This initiative will also support research to help reduce the impacts of electricity generation, especially hydropower generation, on aquatic species and habitats as well. Three thousand megawatts of non-federal hydropower generation in the state will be up for relicensing by the Federal Energy Regulatory Commission within the next ten years. Since these licenses are for thirty to fifty years, it is critical that the necessary tools and information be developed to inform this permitting process.

This initiative will also support research to reduce water demands from the electricity-generating sector. A major source of water consumption from fossil fuel and renewable generation is the water used for steam condensation, commonly referred to as power plant cooling. While there is water conserving cooling technologies available, such as an air-cooled condenser, which reduces water demand for cooling to zero, there are cost and performance penalties associated with their use. There is also a need for research to inform future renewable energy siting for offshore wind and wave technologies. Under this initiative, ecological information, tools and methodologies will be developed to proactively determine potential environmental impacts prior to full-scale deployment of offshore wind or wave energy conversion technologies.

Background: The U.S. DOE, the Electric Power Research Institute and others have conducted research on ways to reduce water demand from electricity generation, specifically through the use of air-cooled condensers or the use of water sources not suitable for agricultural or municipal uses. Research on air-cooled condensers has sought ways to reduce the heat and wind effects on condensers while degraded water research addressed the challenges of using such water from different sources in power plant cooling towers. Research by John Maulbetsch and the University of California, Davis are assessing the best use of wind barriers to reduce wind effects on air-cooled condensers.

The University of California, Davis, the U.S. Forest Service, Garcia and Associates and other conducted research on the effects of hydropower ramping flows on aquatic ecosystems. H.T. Harvey and Associates has conducted an environmental knowledge gap analysis for wave energy development in California.

NOAA/s HMT, California's DWR, and Scripps Institution of Oceanography are deploying a state-of-the-art atmospheric river monitoring system for California and are developing decision support tools focused on precipitation prediction. CEC has advanced the understanding of how atmospheric rivers impact precipitation in the Sierra Nevada, including the role of aerosols in modifying clouds and precipitation. HRC has developed a modern tool for coordinating operations across multiple reservoirs.

From pages 76-77

S5.4 Proposed Funding Initiative: Develop Analytical Tools and Technologies to Plan for and Minimize the Impacts of Climate Change on the Electricity System.

Issues: Recent research has shown that over the next few decades the electricity system is highly vulnerable to climate change and extreme events. The information generated so far, however, has been designed to estimate the seriousness of the impacts and has looked mostly at what would happen by the second half of this century. The rapid evolution of the energy system must also be taken into account given the ambitious greenhouse gas (GHG) reduction goals adopted in California. This evolution should be guided with information that facilitates the creation of a more climate-resilient energy system. It is unlikely that programs other than EPIC would be able to generate the scientific and engineering information needed to create a more resilient electricity system in California.

Purpose: This initiative will produce practical information on GHG mitigation, impacts, and adaptation that informs policy deliberations at the CPUC, Energy Commission, and other jurisdictions. The main focus will be on mitigation, impacts, and adaptation options for the next few decades since that is the timeframe used to develop energy policy.

To better assess potential climate change effects on the state's energy system, this initiative will improve climate change projections for California. Current climate change projections focus on temperature and precipitation with a very crude treatment of important variables such as wind and solar radiation. The proposed new research will improve the simulation of wind, ground-level solar radiation, relative humidity, and other parameters of importance to the energy sector and will refine projections of temperatures and precipitation that still contain significant uncertainties, especially on local-to-regional scales within California.

This initiative will also improve the depiction of high elevation hydropower units in water models under different climate scenarios. Current simulations only address low elevation hydropower units. Including high elevation hydropower units is essential because research shows that climate change would cause high levels of spillage from high elevation hydropower units during the late part of the winter season, creating water management problems for low elevation reservoirs and their associated hydropower units. Improvements in projections of streamflow and water supply for all hydropower units across California is required as regional variations in projections are significant, including the effects of likely changes in aerosols and storm tracks on precipitation.

This initiative will also address the energy implications of adaptation measures. California has begun to identify and implement adaptation measures that may substantially affect energy generation and demand. For example, water agencies are investigating the use of natural groundwater reservoirs to store water during wet years and to lessen the effects of expected snowpack decline in the Sierra Nevada mountains. The energy demand implications of pumping water from these groundwater reservoirs is unknown. Research to identify the energy consumption implications of different adaptation options under consideration now and in the future is also needed.

This initiative will also research the potential evolution of the energy system to identify how the energy system will need to change to drastically reduce GHG emissions while avoiding or minimizing environmental impacts.

This initiative will use a practical approach by delving into engineering design issues for concrete steps that could be taken by electricity system managers. The research focus is on practical engineering applications that produce actionable products, but will also look at economic issues, including econometric and economic experiments, as needed to fully evaluate mitigation and adaptation opportunities. For example, Pacific Institute research has shown that with sea-level rise some coastal power plants will be in danger of coastal flooding. What is needed now are engineering studies to identify when the problem would materialize, what specific actions should be taken at these power plants, and what alternatives are available. The same can be said about effects of climate change on hydropower units. Researchers have developed models that can adequately identify overall system impacts but are unable to generate practical local information that can be used to implement actionable adaptation measures at specific hydropower units.

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Background: California leads the nation on climate change research. While there are national research efforts by different federal agencies, including the U.S. DOE and the National Academy of Sciences, they will not specifically address California and the unique challenges that climate change will present to the state. Non-governmental organizations have also expressed strong support for the spirit of this initiative in comments submitted to the CPUC by The Nature Conservancy, the Natural Resources Defense Council, the Union of Concerned Scientists, the Sierra Club, the Environmental Defense Fund, and others during the deliberations that culminated with the creation of EPIC.