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Research Needs for Advancing the Water-Energy Nexus in California

Additional submitted attachment is included below.

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California Energy Commission
1516 Ninth Street
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To the California Energy Commission,

California represents a unique region where both the water and energy sectors are concurrently undergoing significant transformation in response to resource security and environmental impact concerns, especially under the forcing of climate change. To meet the water supply, water quality, and energy needs of California's residents moving forward, it is important that these transformations occur in ways that do not impede each other's goals. To better advise this process, we have identified the following research needs for improving the co-beneficial interaction between evolving water and energy sectors:

First, the flexibility of water-infrastructure related electric loads must be quantitatively characterized taking into account the constraints of physical process dynamics. While there has been significant work in improving the energy efficiency of water-infrastructure related electric loads, as the electricity system moves to incorporate more variable renewable electricity generation, the ability of electric loads to be shifted and timed to coincide with this generation without compromising their core functions becomes more critical. Processes in water and wastewater treatment facilities, however, are constrained by the responsiveness of their physical and chemical processes that determine the rate at which the associated electric loads can change and the duration over which they can respond. Further, permits for treatment facilities require adjusting dynamically the process operations. This imposes a dynamic treatment overlay onto the power generation and pricing dynamics of electrical utilities. Moving forward, characterizing the load flexibility potential taking these dynamics into account will be critical to understanding the extent to which these can provide benefits to local and regional electricity systems.

Second, the benefit of enabling flexible water infrastructure-related loads for plans to meet California's energy-related policy goals such as SB100 should be systematically characterized. Increased load flexibility to better align electric loads with zero-carbon generation on the electricity system provides the benefits of reducing the scale of energy storage needed to meet increasingly strict zero-carbon goals. Additionally, flexibility in electric loads on the distribution side of the electric grid can potentially also reduce transmission congestion and the need for additional transmission infrastructure. Quantifying these benefits is co-beneficial in that it not only supports cost-effective SB100 planning but also identifies the potential base of funds that can be used to incentivize water utilities for investing in load flexibility.

Developing a further understanding of these topics and addressing these needs can be accomplished by leveraging the existing research expertise of the University of California system. At UC Irvine in

particular, expertise on water and wastewater treatment process dynamics and energy system integration under low-carbon and high renewable penetration goals are currently being leveraged in research that is relevant to California's policy goals. We look forward to engaging in the process for bolstering research at the interaction between water and energy and aim to work with other stakeholders to identify and pursue research needs of importance in these areas.

Sincerely,

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