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October 10, 2012



EPIC
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814

Dear Commissioners and EPIC Administrators:

The California Council on Science and Technology currently sponsors a committee on California's Energy Future. This committee has produced a series of reports related to reducing GHG emissions 80% below 1990 levels by 2050 as set out in S-3-05 (and now, as well, B-16-2012 covering the transportation sector) which can be found at www.ccst.us. Based on this work, we are writing to urge that the CEC EPIC Investment Plan include support for basic research and deployment strategy analysis related to reducing greenhouse gas (GHG) emissions 80% below 1990 levels by 2050 as set out in S-3-05.

We note that three recent independent studies of what is required for California to meet the 80% goal (the aforementioned California's Energy Future committee convened by the California Council on Science and Technology,[1] a second by a team from Energy & Environmental Economics (E3) and Lawrence Berkeley National Lab (LBNL),[2] and a third by UC Berkeley and LBNL[3] that included contributions from UC Davis and Itron) found that decarbonizing electricity generation, electrical end-use efficiency, and electrifying existing fossil fuel uses in transportation and other sectors are all required for meeting the 2050 standard. All three reports conclude that electricity plays a central role in making radical emission cuts. Because electricity infrastructure is long-lived, it is important that near-term decisions affecting the electricity sector are made with a pathway to 2050 in mind. EPIC-supported research can play a vital role in making better decisions. These planning issues integrate new generation facilities, the future of the transmission and distribution system, and end-use and demand side-management.

While many areas in the draft IP are already on the right track, we'd like to point out what we think are key areas for new research based on our understanding of 2050 technology requirements. These recommendations were prepared in consultation with members of our CEF team, listed in Exhibit A attached to this letter.

- **Conservation and Energy Efficiency:** GHG reductions from behavior and lifestyle change may potentially be large. There are untapped opportunities for better use of smart meter data in energy

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[1] CCST (2011), *California's Energy Future: The View to 2050*, http://ccst.us/publications/2011/2011energy.php
[2] Williams et al (2012), "The Technology Path to Deep GHG Emissions Reductions by 2050," *Science*, http://www.ethree.com/publications/index.php
[3] Wei, M., J. H. Nelson, J. B. Greenblatt, A. Mileva, J. Johnston, M. Ting, C. Yang, C. Jones, J. E. McMahon and D. M. Kammen, "Deep Greenhouse Gas Reductions in California Require Electrification and Integration Across Economic Sectors," submitted to *Proceedings of the National Academy of Sciences*, 14 September 2012; Nelson, J. H., Johnston, J., Mileva, A., Fripp, M., Hoffman, I., Petros-Good, A., Blanco, C., and Kammen, D. M. (2012) "High-resolution modeling of the western North American power system demonstrates low-cost and low-carbon futures", *Energy Policy*, **43**, 436–447.

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efficiency program design and implementation. Building retrofit policies have so far had limited success. All these areas require a much stronger analytical foundation based on well-designed observational studies, data collection and investment in social science and policy research.

- **Grid reliability with high levels of non-dispatchable generation.** All future low-carbon electricity portfolios, and especially those with high levels of intermittent renewable energy, will require balancing resources on a variety of time scales, from seasonal storage to intra-hour flexibility to sub-cycle frequency regulation. However, the types and amounts of these resources required under different conditions, and how they should be incorporated into electricity planning, remains poorly understood and needs additional research.

- **Climate change impacts on electricity generation resources and demand.** For long-term electricity planning, standardized methodologies are needed for treatment of potential climate change impacts on weather-dependent load and hydroelectric, wind, and solar generation, and changes in demand patterns. This includes standard methods for downscaling and applying general circulation model results.

- **Strategic role of carbon capture and sequestration (CCS).** This technology has experienced numerous setbacks in the State and nationwide, yet it remains an important GHG mitigation strategy, both for electricity generation and possibly other applications, such as negative net GHG biofuel production. Further research into the efficacy, cost, and early market opportunities of CCS is required to determine the role it may play in a 2050 energy strategy.

- **Comparative environmental impacts of electricity alternatives.** Different low carbon electricity systems – e.g. high nuclear, high CCS, high central station renewable, and high distributed renewable – have very different resource requirements and environmental impacts. The types and amounts of these resources required under different conditions, their locations and the nature of transmission planning for them, and how they should be incorporated into electricity planning remains poorly understood and needs additional research. There is a pressing need to develop consistent environmental metrics for use in the planning process. Currently, environment is a separate regulatory concern, not a basic input to planning.

- **Electrification.** Basic research is still required on electrification potential for many applications, for example replacement of fuel use with electricity in buildings and industrial processes and in dramatically scaled-up use of electricity to power transportation. Understanding how to align incentives and coordinate infrastructure rollout is essential for electric vehicles and other forms of electrification to succeed.

- **Resource potential and GHG impacts of biomass energy.** The largest remaining source of GHG emissions after efficiency, electrification and low-carbon electricity generation is fossil fuel combustion. Substitution with biomass, either directly through biofuels (with or without CCS), or indirectly through biomass electricity with CCS, is a key strategy. However, biomass resource potentials—both within and outside California—are poorly characterized and may be severely limited. Life-cycle GHG impacts of different bioenergy pathways remain controversial and poorly understood. Environmental, economic and social impacts of large-scale bioenergy production are also required to avoid unwanted consequences.

- **Non-energy and non-$CO_2$ GHGs.** Methane, nitrous oxide, high-GWP gases, and non-energy $CO_2$ from the manufacturing, agriculture, and forestry sectors could exceed the entire 2050 GHG budget of 85 MMT in a business-as-usual case; they could also provide critical low-cost offsets. However, mitigation potential and cost are much less well-understood for these gases than for the case of $CO_2$ from energy use.  Much basic technical and policy R&D is needed in this area.

Thank you for considering our recommendations.  Please contact us if you have any questions.

Sincerely,

Dr. Jane C.S. Long, Chair
California's Energy Future Committee

Dr. Mim John
CCST Council Chair

**Exhibit A**
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