Feedback on California Clean Energy Future Proposed Metrics
Docket number 11-IEP-1A California Clean Energy Future

Prepared by
Jane C. S. Long, co-chair
California Council on Science and Technology's
California's Energy Future Committee

The California Council on Science and Technology recently released the results of a two-year study of California's Energy Future focused on evaluating our technological readiness to meet the requirements of S-3-05 which sets a target of 80% emission reductions below 1990 levels by 2050 (www.ccst.us).

The California's Clean Energy Future effort is focused on coordinating, monitoring and managing the states efforts in regard to the states electricity sector in light of the AB32 family of statues over the next 20 years and, as well mentions the long term goals of S-3-05. CEC is also updating the 2010 IEPR in coordination with CCEF.

This testimony is to show where the efforts and results of the CCST/CEF report and committee may be of use to the state in the CCEF and IEPR process.

The CEF project developed a methodology for identifying energy systems that would

1. meet the needs of a growing population and growing economy in California

and

2. meet the emission targets of S-3-05

We first estimated the BAU demand for electricity and fuel based on a moderate amount of population and economic growth. Then the methodology had four key steps *all based on using technology we largely know about now*:

1. Determine the maximum reasonable amount of efficiency improvements by 2050. We did this as a bottom up estimate in buildings, industry and transportation.
2. Determine the maximum reasonable amount of electrification or use of hydrogen that could occur by 2050. We did a bottom-up estimate of electrification of transportation and heat.

   The results of steps 1 and 2 then modified the demand for electricity and fuel.

3. Examine options for producing electricity without emissions using nuclear power, fossil fuel with CCS, or renewable energy, while accounting for load balancing in all cases.
4. Examine the expected amount of biomass available for biofuel and the expected technology improvements in making biofuel, and some best options for using biomass.

The net result is that most remaining emission result from a remaining requirement for fuel as there is likely not enough biomass for all our needs. For the electricity sector, we found that significant emissions would be associated with load balancing if we used natural gas for this purpose, especially for electricity portfolios that are largely intermittent resources.

Consequently, the CEF report contains estimates of feasible build-rates and roll-over rates using technology we largely know about now in order to meet the 2050 emission target. Significantly, these feasible build rates would not allow us to meet this target. We estimate that this effort would result in emissions that are about 60% below 1990. The remaining emission cuts could also be achieved, but this will require much more technology innovation.

All remaining emissions have to do with continued use of fossil fuel, either because the end use cannot be electrified or it is needed for load balancing. Based on our estimates, the amount of biomass that may be available to meet the need for low-carbon fuel is likely to be insufficient to meet demand. We found that load balancing with fossil fuel would likely make it impossible to meet the emission targets of 80% below 1990.

1. We recommend that California monitor progress towards the 2050 goal, much as CCEF proposes to monitor progress towards the 2020 goal.

The staff of CEC, CARB and CaPUC have recommended metrics to monitor progress for CCEF. For each of these I will comment on how the CEF work could support and enhance this effort:

Greenhouse Gas Emissions : We recommend that we not only monitor emissions, but we monitor these as compared to an estimate of where we should be if we are to meet the 2020 and 2050 targets along a linear trend. The required trend should also be updated.

Energy Efficiency: CEF contains extensive estimates of efficiency progress in three sectors: building, industry and transportation. CCEF recommends monitoring performance vs goals for electricity and natural gas savings. We recommend that staff work with CEF to develop a comparison between CEF feasible improvements in efficiency over time with monitored data.

Demand Response: the CEF did not study demand response *per se* except as part of a suite of technologies needed for load balancing. See comments below on monitoring emissions from load balancing.

Renewable Energy: CEF analysis suggests that the state should collect information about the load balancing history of the renewable energy portfolio. Eventual meeting of the 2050 standard will require solving the problem of load balancing

without emissions. It is important to understand how the integration of intermittent renewables changes the need for load balancing technology.

Installed Capacity: We support this metric and suggest that the installed capacity be compared to the build-out rates required for the 2050 standard. These are given in the CEF report.

Transmission Expansion: CEF has no particular contribution to this metric.

Electric Vehicles: CEF contains a projection of electric vehicle fleet growth over time to meet the 2050 standard. We recommend that CCEF compare growth of electric vehicles to this projection.

2. CEF would recommend that the state monitor these additional metrics:

1. *Total electrification:* Meeting the 2050 standard requires electrification of light duty transport, bus, rail, and heat. We recommend keeping track of electrification of bus, rail and heat.
2. *Emissions from load balancing activities.* We have seen that emissions from load balancing could alone exceed the 2050 standard and we recommend monitoring the amount of natural gas that is used for firming power. We think it is very important to not only keep track of the amount of renewable power generation, but also associate this generation with emissions that are required to firm this power.
3. *Biomass supplies for energy and the disposition of these into gas, liquid fuel and electricity.* We found some evidence that a certain amount of biomass would best be used to make electricity. The wise disposition of this biomass will require a good understanding of how much biomass is available for energy and how it is used.
4. *Monitor the upstream emissions of producing fuels in any assessment of fuel-burning activities (like load balancing)*. While these may be counted elsewhere in the economy (e.g. petroleum & nat gas refining/delivery), it is important to consider them as part of these fuel emissions, since reduced reliance on these fuels would reduce those upstream emissions as well. For example, the CEF analysis counted upstream emissions and this is the origin of the observation that load balancing alone on renewables could exceed our statewide target.

3. Update CEF estimates based on new data*:*

We suggest that the 2050 projections of required technology adoption such as those made by CEF should be updated along with the IEPR schedule. For example, meeting the 2050 target is highly dependent on population and economic growth. These estimates will change significantly over time. As well, as the state makes changes to the energy system these will change the projections for 2050.

4. Provide a focus for technology development and policy choices:
The CEF analysis shows that meeting the 2050 goals will require some key policy choices and new technology. Some key questions that emerge from this study include:

- How will building retrofits be funded?
- What is the optimal zero-emission electricity portfolio for economics and reliability? How much baseload electricity generation do we need to plan on and what should it be?
- How will we eliminate emissions from load following, especially for intermittent resources?
- How much California biomass can we expect to have for energy use and what is the best use of this biomass?
- What are alternatives beyond biomass for low-carbon fuel?

The issues raised by the CEF analysis can help to focus further study.