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Senate Environmental Quality Committee and the Select Committee on AB 32 Implementation and Climate Change - AB 32: Implementation through 2020 and Beyond
Testimony delivered by:

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I would like to begin by expressing my thanks and admiration to the work that the State of California is doing to chart and implement a path that makes energy, economic, social, and environmental sense for our citizens, our region, and the planet.

My own work at the University of California, Berkeley, would not be possible without the financial and intellectual support of the CEC, the CPUC and CARB.

First and foremost, the open, deliberative, and fact-based process that the State of California is pursuing through its agencies has become a global model for gaining shared understanding. In this effort we highlight and vociferously debate challenges, and ultimately and most critically, implement solutions.

Recommendation 1:

This focus on climate leadership is not just a high-concept platitude. This is a critical observation. In my role as the Energy and Climate Fellow working for the U.S. Secretary of State[1], I can document that the California Global Warming Solutions Act is demonstrably inspiring communities, states and nations worldwide to innovate and act. This focus on an evolving AB32 process **has brought investment in, and business opportunities to, California-based companies**[2]. **California should expand the number and scope of state-to-state and international partnerships around climate solutions.**

California's interim targets under AB32 are vital to enabling and ensuring continuing **use-inspired innovation that focuses talent on clear but challenging objectives.** The climate imperative is getting more and more immediate and more and more costly. Fires, droughts, crop failures, and other extreme weather events as detailed by the American Meteorological Society[3], and the

[1] http://www.state.gov/r/pa/prs/ps/2010/04/140288.htm
[2] For an online interactive cleantech jobs calculator, see Wei, Patadia and Kammen (2010), and: http://rael.berkeley.edu/greenjobs
[3] https://www.aip.org/commentary/ams-convenes-examine-extreme-weather

Intergovernmental Panel on Climate Change (IPCC) for which I have served as an contributor and as a Coordinating Lead Author since 1999. The clear message from these data is that we must **maintain or accelerate our momentum to meet the state's climate targets.** The open letter to Governor Brown that I helped to author, and am proud to have signed with the Union of Concerned Scientists and a remarkable group of colleagues[4], highlights the increasingly dire climate data, and the vital and beneficial role that California's proactive approach has taken to generating and profiting by solutions that AB32 had driven.

To enable accelerated learning and innovation (and profitable investment) around the interacting suite of climate, water, energy, job-creation and ecological innovations, my laboratory has built a series of electricity grid capacity expansion models called SWITCH (Solar, Wind, Integrated with Transmission and Conventional sources)[5]. These models are in use today in California, across the WECC, in Chile and China, and under development for India, East Africa, and Mexico. We use the SWITCH model, a large linear program, to evaluate 'what if' scenarios.

Recommendation 2:

To continue and expand our ability to build a climate-friendly, job-creating, economy, **interim targets in 2030 and 2040 are vital** to streamline and focus the research and development efforts to feed the research, development, and deployment (RD&D) pipeline.

In particular, our analysis of the California and WECC energy system using the SWITCH model very clearly indicates that:

- A 2030 and 2040 RPS and carbon reduction target are both vital to providing the state with the capacity to control costs and maximize job creation in the energy, water and land use/management sectors. **Specifically, I recommend a linear or faster decarbonization path from 2020 to 2050 with milestones in 2030 and 2040.** My research group is currently exploring scenarios where we reduce emissions *more* than by 80% from the 1990 baseline. This is likely to be needed. Thus, a target in 2030 of 33% below 1990 levels, and 66% below the 1990 levels in 2040 would be prudent. Later reductions may prove more difficult, so early action is vital.

- Coordinated targets such as the Million Solar Roofs and Million Electric Vehicles targets mutually reinforce each other, and drive the sort of job creation that will make California more and more competitive globally as these standards diffuse around the world. The dramatic increase in manufacturing in California as evidenced by Tesla Motors vehicle and battery initiatives[6], and other EV startups, highlights the benefits that come from this systems-level approach to challenging targets for energy efficiency and clean energy commercial deployment opportunities.

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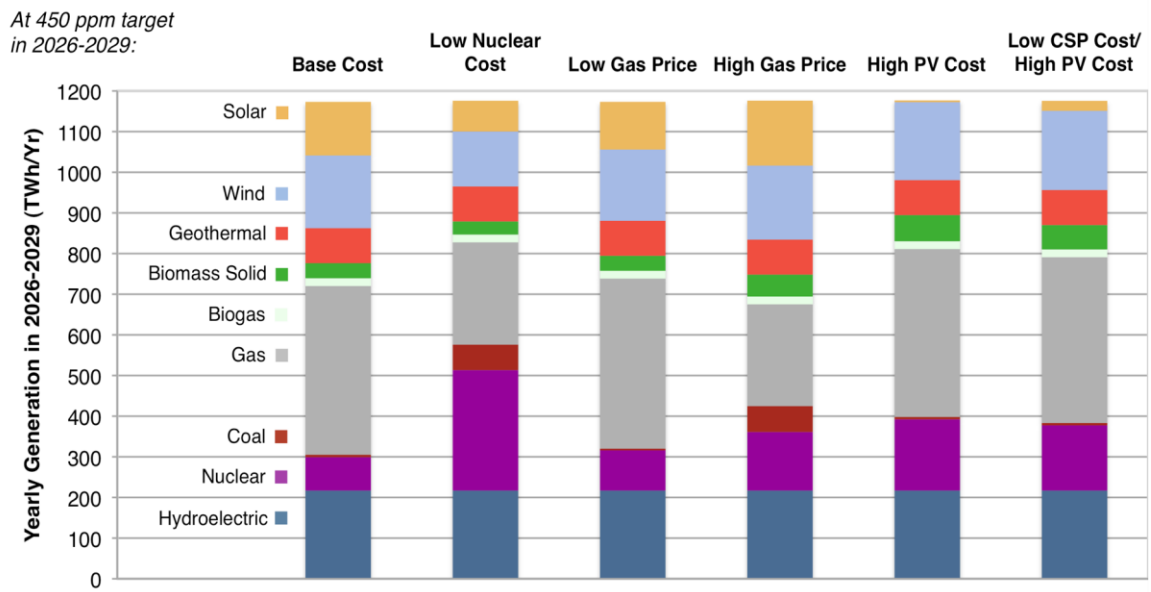
[4] http://www.ucsusa.org/news/press_release/california-scientists-urge-emissions-reductions-0397.html: Title: **California Climate Scientists and Economists Urge Governor and Legislators to Make Steeper Reductions in Global Warming Emissions**

[5] To access the SWITCH models, see http://rael.berkeley.edu/switch. This work has been supported by in part by the CEC.

[6] http://blog.sfgate.com/inthepeninsula/2014/03/07/tesla-alternative-energy-future/

Extensive analysis with the SWITCH model bears out the benefits of this approach (Mileva, *et al*., 2013*).* The recently announced storage mandate for California is a perfect example of this process. The state should consider a series of *system-level* targets, such as those that incentivize both mobile (electric vehicle) and stationary storage capacity at California residences and businesses, and should identify opportunities for community and regional mini-grids that enhance supply reliability, cost certainty, and interact usefully with the IOU and municipal utilities across the state.

We find that California could meet its 2050 climate goals two decades earlier, in 2030, through a number of different technology-facilitated pathways. For each the cost is negligibly different from the **Business as Usual** cost forecasts. The key – which is difficult to achieve – is coordination between investments in energy efficiency, energy generation, and the construction of the transmission and distribution network needed to enable this systems (Nelson, *et al*., 2012; Wei, *et al.,* 2013; Mileva, *et al*., 2013).



	Base Cost	Low Nuclear Cost	Low Gas Price	High Gas Price	High PV Cost	Low CSP Cost/ High PV Cost
Carbon price adder ($2007/tCO$_2$)	70	59	87	66	84	86
Power cost ($2007/MWh)	113	110	110	114	114	114
Cumulative new transmission built by 2030 (10^3 GW-km)	9.8	6.0	9.0	11.7	12.0	12.3

Figure 1: Example scenarios generated with SWITCH (Nelson, *et al.,* 2012; Wei, *et al.,* 2013) for California to meet 2050 climate targets two decades early by coordinating investments in energy generation, energy efficiency, and transmission and distribution. No specific scenario is *a priori* superior to another, but each illustrates the vital need for coordination on the full generation to end-use innovation and delivery pathway for energy in California. Work supported by the CEC, CARB, and CPUC in the RAEL/LBL partnership (PI: D. M. Kammen).

Recommendation 3:

Citizen, community, and business engagement – indeed *excitement* over the steps and objectives -- is vital to the sustainable energy and sustainable society process. We must focus on the means to make behavior change profitable and easy, and to build new partnerships that clarify and expand the benefits of a low-carbon economy to socioeconomically, ethnically, and other disadvantaged communities and individuals, and that make the business case for a sustainable economy clear to the private sector both in and out of California.

In a recent project supported by the California Air Resources Board, we have found that climate protection can lead to immediate economic and quality of life improvements. In the Cool California Challenge[7] we have found that residential cost savings, improved air quality are only two of the immediate benefits that can come from attention and management of your carbon footprint.

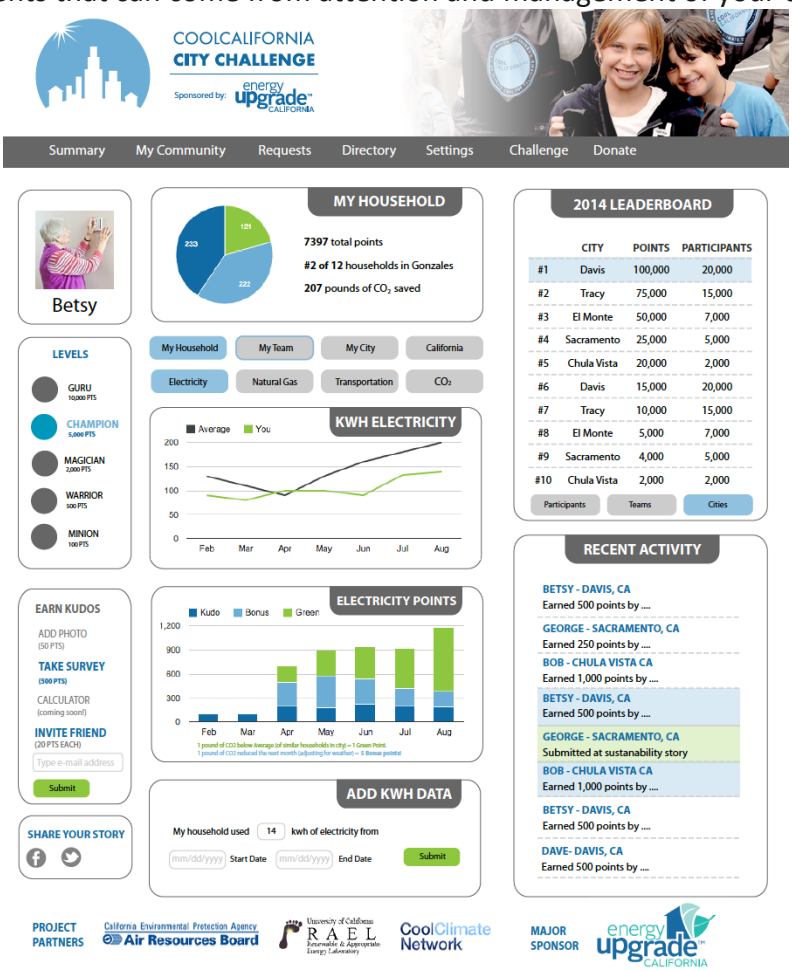


Figure 2: Snapshot of the homepage of the cool California city challenge website.

A particularly important aspect of visualizing not only ones own carbon footprint (Jones and Kammen, 2011) *but also the average over a local area, in this case by zip-code* (Jones and Kammen, 2014) is that **this information empowers individuals to act**. In fact the 'take action' pages on the Coolcalifornia.org website have been a huge source of excitement and conversation among users looking for means to

[7] http://www.coolcalifornia.org/community-challenge/

reduce *both their carbon footprint and household expenditures* (Figure 3). The interactive maps generated have see user access and download levels of 100,00 online views/day, and have facilitate conversations about the embedded carbon in the good, services, and food we consume. **California must develop a plan to account for these embedded emissions in AB32.**

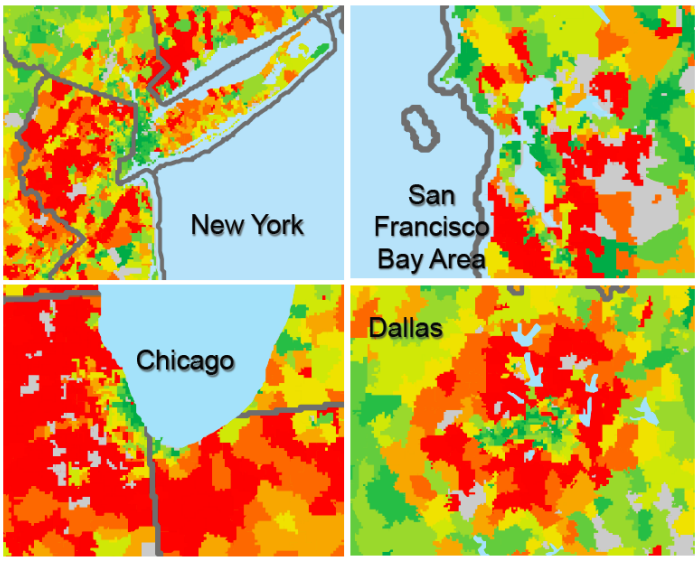


Figure 3: The carbon footprint of U. S. urban areas at the zip-code level (Jones and Kammen, 2014). The interactive calculator and map is available at: http://coolclimate.berkeley.edu.maps. These color-scaled plots reveal the 'carbon shadow' of suburban consumption around often quite low-carbon urban cores.

References: all available at http://rael.berkeley.edu

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