My name is Lucas Davis and I am Associate Professor at UC Berkeley at the Haas School of Business. As most of you know, Haas is one of the top business schools in the country -- #7 in the latest U.S. News rankings. Haas is also a world-renowned center for innovative research in economics and other fields. My colleague, Oliver Williamson, won the Nobel Prize in Economics in 2009.

I am a faculty affiliate with E2e -- a Sloan-foundation funded joint research initiative between Berkeley and MIT aimed at better understanding energy efficiency. And an affiliate with the Energy Institute at Haas. In two weeks, on Friday March 22nd, we host the 18th annual POWER conference on energy research and policy. You can check out the schedule, and register at the EI@Haas website.

California has spent $15 billion on energy-efficiency over the last 30 years. Yet we know very little about what works and doesn't work. Most of what we know comes from engineering analyses. Studies like McKinsey's "Unlocking Energy Efficiency in the U.S. Economy'', from which the image on slide 4 is drawn, use engineering models to calculate returns to energy-efficiency investments. Economists have pointed out for decades that there are several reasons why actual energy savings may be smaller than engineering estimates.

In recent work, I evaluated a national appliance replacement program in Mexico that since 2009 has helped 1.5 million households buy new refrigerators and air-conditioners. The results are surprising, and, unfortunately, pretty disappointing. As shown on slide 5, we find that refrigerator replacement reduces electricity consumption by an average of 11 kilowatt hours per month. This is real savings, but it is only ¼ what was predicted by engineering estimates from the World Bank and McKinsey.

What happened? The refrigerators that were replaced were not the worst offenders. Most of them were only 10, 11, and 12 years old --

whereas the engineering estimates assumed most would be 20 years and older. In addition, households upgraded to larger refrigerators, with additional features like through-the-door ice. These upgrades are valued by households but substantially offset the potential efficiency gains.

In evaluating this program, we also found that more than half of participants are "free riders", receiving a rebate for doing something they would have done anyway. Slide 6 shows that households receiving very different rebate levels (e.g. $110 vs $30 vs $0) actually replaced their appliances at very *similar* rates. The results in the study imply that many participants would have replaced their appliances for much smaller rebates, or even with no rebate whatsoever. All of this overpayment makes the program considerably less cost-effective.

These findings corroborate a couple of the key concerns that economists have had for a long time about energy-efficiency programs.

How can California ensure that investments like this reduce energy consumption? Slide 7 describes a three step plan that will guarantee that taxpayer money is used wisely.

First, it is critical to *collect data*. One of my favorite lines is, "In god we trust, everyone else bring data." (quote by Edward Deming, Statistician). This means transparency about how much money is spent and it means current and historical energy consumption microdata for participants and non-participants. This seems obvious, but most programs today are not being properly evaluated because data is not collected.

Second, these data must be made publicly available. In my years as a professional economist, I have seen what independent researchers can bring to difficult problems. Lawrence Berkeley Lab, UC Berkeley, and other UC campuses are full of researchers who would be thrilled to apply their experience and talents to evaluating California's energy-efficiency programs. If these evaluations are to be credible, it is critical that these

studies be performed by non-stakeholders. And data can be stripped of identifying information prior to making it publicly available, eliminating any potential privacy concerns.

Third, we must design programs to facilitate evaluation. This must be done at the very beginning, not as an afterthought. Serious analysts recognize that it is actually quite difficult to measure energy savings accurately. Customers are very different -- so it is hard to compare participants to non-participants. And comparisons over time are hard to make, because patterns change.

How do we design programs to facilitate evaluation? On this we can draw valuable lessons from the private sector. Companies like Google are constantly evaluating everything. And how exactly does Google do it? By flipping a coin. Half the people see one website, the other half see a different website. This allows them to immediately see what works and what doesn't work.

When spending taxpayer dollars, we should use the same approach. In addition to being the best approach for evaluation, this is the fair way to allocate scarce dollars. Take Prop 39, for example. It would be impossible to weatherize all the k-12 schools in California next year. So ``flip a coin'' to see which schools go first. This gets the process moving in a non-political way, and makes evaluation possible, allowing us to learn what works and doesn't work. This learning can then be incorporated the following year, ensuring better and better results.

California has a tremendous opportunity, not just with Prop 39, but with all of these resources for energy efficiency to be a world leader in program evaluation and execution. Collecting data, making it publicly available and designing programs to facilitate evaluation will help guarantee this success. I look forward to speaking more with all of you. Thank you.