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A New Energy Efficiency Manifesto: California Needs a More Integrated, Cost-Effective Approach

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By Cynthia Mitchell

Electricity Policy – the website ElectricityPolicy.com and the newsletter Electricity Daily – together comprise an essential source of information about the forces driving change in the electric power industry.

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A powerful verse from the Book of Ecclesiastes was turned into a moving song by Pete Seeger and popularized by The Byrds as "Turn! Turn! Turn! (To Everything There Is a Season). It seems an appropriate anthem for the utility industry today. The electric power industry in California is at a crucial season of change: meeting state and federal environmental initiatives; planning and implementing diverse resources to continue meeting the energy needs of its people and its economy, cleanly and at lowest cost; and answering novel operational challenges previously unseen in the industry.

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I. Background: What's Right, What's Wrong with Energy Efficiency?

Ironically, at the center of the answers that must be developed is a re-visioning of a resource so familiar that it is taken for granted: energy efficiency. This paper will describe how energy efficiency, a distributed energy resource (DER), can be depended upon on a long-term basis and combined with other DERs—distributed generation, demand response, and storage—to meet both grid-scale and local distribution service challenges in a way that none of them can do alone.

I will describe the current state of play before turning to potential solutions, and to technology that can make them possible.

The utility industry is at an unprecedented crossroads, pressured to respond to state and federal climate-related initiatives, rapidly evolving distributed energy resources, and to consider new business models.

Trillions in investment capital are needed to transform the industry into a green energy economy. Energy efficiency (EE), a key distributed resource, continues to greatly lag its economic potential.[i] Given the widely recognized value of the resource,[ii] it is notable for its underachievement, held back by very short payback requirements and uncertainty over the persistence of energy savings over time.

Historically we have understood increased efficiency as undercutting utility business, presenting a "disruptive challenge." But perhaps the problem has been not that utilities do not want to succeed at efficiency, but that we have not allowed them to succeed. Rather than a "disruptive challenge," optimal efficiency, when integrated with other distributed energy resources (DERs), can offer the utility industry a "compelling opportunity."[iii]

Rather than a 'disruptive challenge,' optimal efficiency, when integrated with distributed energy resources (DERs), can offer the utility industry a compelling opportunity.

Efficiency, combined with other forms of distributed energy resources (DER), such as demand response (DR), energy storage (ES) and distributed generation (DG), can be a new utility asset type. It can supply a powerful new utility resource based on the availability of flexible load management and reliable measurement techniques and devices. But to realize that vision will require transaction solutions designed to match core utility attributes, not undermine them.

Utilities as participants in the regulatory compact were designed to succeed—that is, generate profits for their investors—by acting as the capital formation engine of the community energy grid. As it is, utilities have little if any invested capital in behind-the-meter efficiency and other DER. In California, efficiency is an expensed cost, and contributes little to utility earnings.[iv]

The electric utility industry is second only to railroads as the most capital intensive industry

in the country. Sales decoupling mechanisms do not change the underlying basis of the utilities' business model. [v]

To deploy efficiency as a new energy resource, we need to better match cash flows to support efficiency investments to the value efficiency provides. Just as kilowatt-hours may flow two ways, source to site and site to grid, industry investments need to do the same. Utilities offer a vehicle, as yet unused, to better accomplish that. Capital markets are increasingly interested in investing in sustainable markets. The potential and opportunity is there for energy efficiency.

Without a more serious approach to efficiency, the pressure to overbuild transmission and distribution will be difficult to resist and costly.

Nowhere is the need for a new structure and regulation of EE delivery, integrated with DER, more apparent than in California. The state faces magnitudes of change in energy-related climate impacts and local reliability of service that are much greater going forward even than in the past five years.[vi] This requires a new urgency to find more robust approaches to financing and scaling efficiency.[vii] Incremental approaches will not get the state to where it needs to go.[viii]

California needs a deeper approach to achieving efficiency savings to reduce system peak demand, energy consumption, and to improve local reliability in Southern California, in particular. Nor is the issue limited to energy efficiency. Distributed energy resources as a resource class—energy efficiency, demand response, energy storage, and distributed generation, including rooftop solar—require long term capital markets investment.

It's best to begin with a realistic look at California's recent history of energy efficiency accomplishments and what they *do not* achieve. California's energy efficiency policies have historically taken the form of regulatory directions to utilities to help consumers conserve and reduce energy use. But there exists a gap between the potential of all the energy efficiency that's cost-effective[ix] and what we are getting: lots of short-lived, quick payback, efficiency measures.[x] This gap has not been shrinking.[xi]

It's not generally recognized, but optimal deployment of distributed energy resources is the core requirement to meet next-generation operational requirements of the grid, including reliability and local capacity needs. Energy efficiency can be targeted to manage load in various ways to benefit grid operation. For example, deployed at significant scale and targeted at times of greatest system stress, efficiency can free up dispatchable resources to improve both system reliability and renewables integration.[xii]

Space cooling requirements are highly correlated to system and distribution peaks. Elevated temperatures increase electrical demand for cooling while decreasing

the distribution system efficiencies. Inefficient HVAC (heating ventilation air conditioning) systems, and the interaction between building load, cooling distribution system, equipment efficiency, and equipment sizing (oversized tonnage), exacerbates "summer heat storm" conditions, when consecutive hot days increase the air conditioning demand disproportionately as stored heat builds up in building mass.

California, particularly Southern California (SoCal), needs site-specific load and energy reductions sufficient in amount (e.g. 25-40% for commercial buildings) to contribute meaningfully and lastingly to local reliability requirements. Concentrated and deep, efficiency, as energy, can be measured at meters and substations. Demand response-enabled high efficiency HVAC in commercial buildings, and homes and residences, is the starting point for bringing down and controlling distribution peaks, improving local reliability, and capacity offsets. Space cooling is a critical end use to turning down the "grid heat." By targeting key substations, DR-enabled HVAC provides very a high-value energy resource, amounting to a win-win by improving grid operations and stability, and as a pathway to more efficiency and distributed resources.

II. The Imperative for Major Change[xiii]

California takes pride in its reputation as the national and global leader in government-directed efficiency policies, the oft-cited proof being the state's lower than U.S. average electric energy use.[xiv] While California's per capita consumption is lower than in the U.S. as a whole, our bright pride may be blinding us from the underlying truth. Analyses from several perspectives indicate that factors unrelated to efficiency programs may be responsible for the bulk of the per capita difference.[xv], [xvi] Also, there is a great deal of uncertainty around estimates of the state's decades-old and more recent historical efficiency program impacts.[xvii] Relying too much on this success story obscures the truth that California's present regulator-utility efficiency construct will be ill suited for addressing the challenges ahead.[xviii]

A. Efficiency Accomplishments Must Be Discounted

Energy efficiency in California is understood as a statistical function that's integrated across thousands of discrete and dispersed efficiency measures.[xix] As a result, efficiency is an *estimation* of savings, not a measurement of metered load reductions. Discounted for load

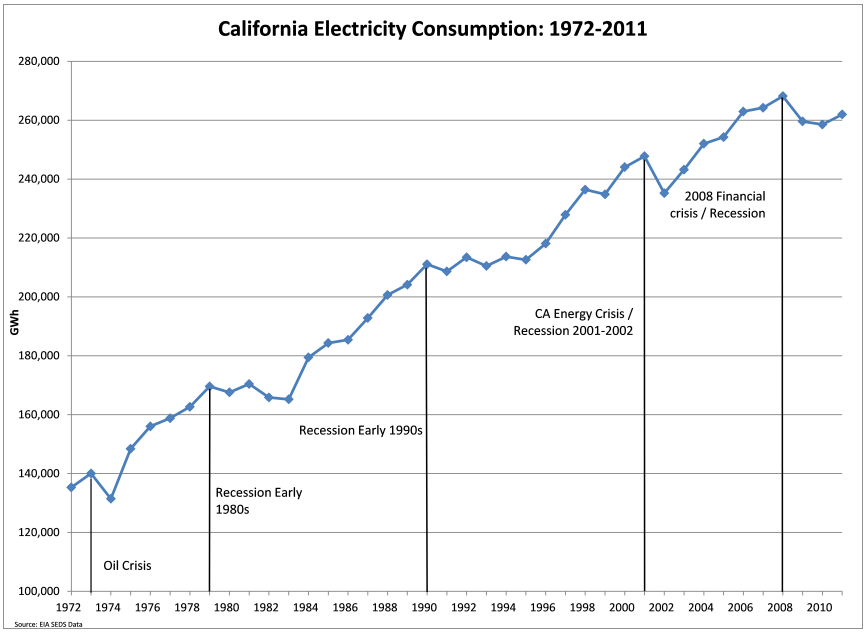


Figure 1

planning purposes and controversial in amount, efficiency savings do not always equate to absolute reductions in load and energy usage.[xx]

Today's efficiency programs contribute to system reliability by modifying the overall slope and duration of energy usage, but not necessarily at the time or location of peak demand.[xxi] Meaningful location-specific correlations of efficiency savings to specific substations and circuits can be hard to establish or predict. From the perspective of the California Independent System Operator, the contribution of energy efficiency to grid reliability, beyond reduction in system wide energy usage, is unclear, given the difficulties in accurately monitoring and measuring efficiency on a location-specific basis.[xxii]

B. Energy and Demand Goals Are Not Being Met

Even with the state's massive ratepayer-funded efficiency programs since California's 2000-2001 energy crisis, energy use and peak loads have increased, and are forecasted to continue to grow.[xxiii] Increasing consumption, in spite of efficiency programs, means that the state will fall behind in meeting its electric sector greenhouse gas reduction targets.[xxiv] Because these GHG emission reduction targets are permanent—requiring sustained reductions in GHG emissions—it is necessary to get ahead of this curve. Efficiency savings that we pursue today must translate into enduring consumption reductions.[xxv] With about one-third of California's annual efficiency savings since 2000-2001 having been achieved from short-lived fluorescent lamps, cumulative savings are decaying over time. Utilities have generally continued to discount the originally installed (or similar) fluorescent lamps, while counting replacements as new savings toward long term cumulative savings. This contributes to an overstatement of efficiency accomplishments.

The only energy efficiency outcome commensurate with the state's global warming policies would be an unambiguous and sustained decline in total energy consumption. Slight variations in the rate of growth still represent movement in the opposite direction of the change that's now mandated. This means that the state needs to redouble its energy efficiency efforts, tying them to measured and sustainable savings to meet its 2020 intermediate GHG targets for the electric utility sector. Even more aggressive savings will be required to meet the state's 2050 GHG targets. With the proper policies in place, the goal should be achievable.

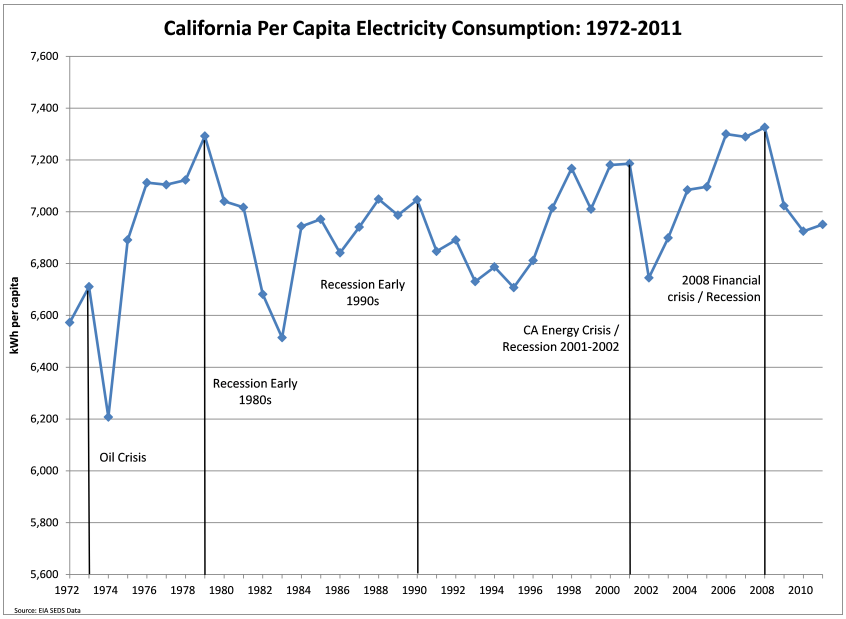


Figure 2

Figures 1 on page 5 and **Figure 2** show California's absolute and per capita electricity consumption 1972-2010, with the five recession periods highlighted. While recessions reveal brief declines in energy use, the overall trajectory of energy use is increasing. Given the historical record, future increases in per capita electricity consumption seem likely if the economy reaches stronger levels of growth. But recessions cannot be counted on as a long-term strategy for managing energy-related climate change impacts.

More worrying is that California's peak demand (absolute and per capita, non-coincident) has been increasing and is projected to continue to increase at rates greater than the growth in energy consumption. System load factors, reflecting the efficiency of asset utilization, have declined and are projected to continue to do so.[xxvi] The increasing rate of peak demand relative to energy consumption, and resultant declining load factors, indicate a greater proportion of homes and business with central air conditioning.[xxvii] (See **Figure 3** on page 7.)[xxviii] The problem is likely to get worse: Continued elevated temperatures will increase the electrical demand for cooling. By the end of the century, the daily per capita peak demand is expected to exceed current 90th percentile peak demand on almost every summer day. A 21 percent increase in peak demand is likely. [xxix]

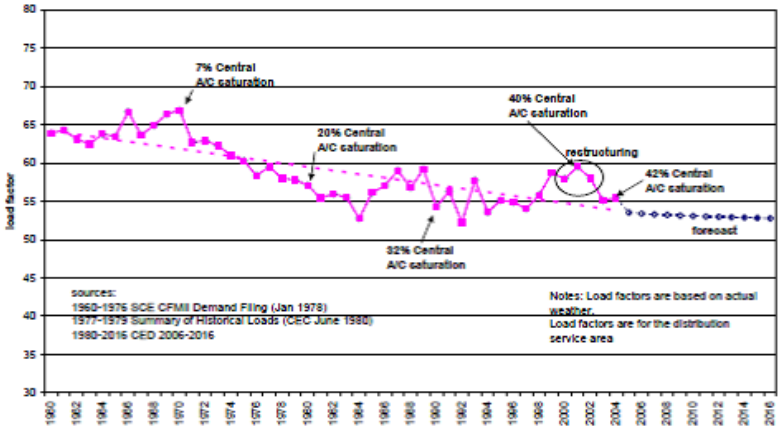
Increased solar PV generation does not mitigate space-cooling peak and critical peak demand, which tends to occur as and after the sun goes down. Near-term projected changes in California's electricity supply curve, showing increasing solar generation paired

with conventional base load resources that can't be turned off (e.g. nuclear and less flexible natural gas), will cause over-generation in afternoon periods beginning in 2018, but that mix will still leave the early evening peak underserved. This phenomenon is commonly referred to as California's "Duck Curve" (see **Figure 4** on page 8): the duck's belly grows during the day with excess generation, requiring a steep ramp down of other generation, while the neck of the duck tracks a steep run-up in late afternoon and evening as solar PV drops off, commercial space cooling continues, and residential space cooling requirements ramp up.

Reliability Problems Must Be Addressed

On top of growing energy requirements, Southern California faces unique challenges in local reliability that are exacerbated by the recent San Onofre Nuclear Generation Station (SONGS) closure, and planned retirements of once-through cooling (OTC) generating units. Local reliability studies indicate that significant demand and energy reductions are needed to avert serious reliability risks. There are important constraints on resource choices to take account of as well. Transmission and distribution upgrades remain difficult within both the Los Angeles and San Diego basins. Emission offsets for new fossil fuel generation are scarce and expensive.[xxx] State policy makers expect energy efficiency and demand response and distributed resources to play a key and increasing role in meeting these reliability needs.[xxxi]

Figure 3



III. Creating a Robust Energy Efficiency Model for California

New Transaction Structures

California energy efficiency programs are positioned to incent higher efficiency equipment and appliances, and more efficient construction and retrofit practices, to encourage and promote deeper and more comprehensive customer investments in efficiency. The gamble by the state is that consumers will be willing and able to make capital investments in efficiency based on longer-term—ten- and 20-year—paybacks. But the state's and national literature are clear that there are significant market barriers to consumer-purchased, consumer-financed energy efficiency, particularly with leased buildings.[xxxii]

New transaction structures are needed to value "efficiency as energy" for capital markets. "Efficiency as energy" is site-specific and correlates well to circuit and substation loads, persistent, and measurable at the meter. Over time, 20-30 + years out, we can reduce building loads by 25-40% by creating long term investment opportunities in efficiency. Building energy savings of this magnitude can be valued for investment purposes as the difference in load and energy requirements pre- and post-efficiency, demand response, and distributed resources.

THE DUCK CURVE
(Net load chart)

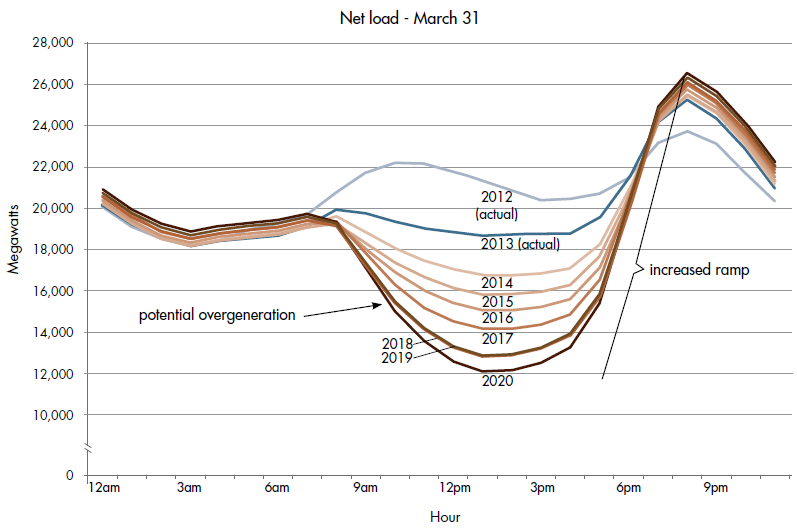


Figure 4

In this new framework, *dynamic baselines* can track over time what a building's energy and load requirements would have been but for energy efficiency and other distributed resources through a series of algorithms that define the building's energy and load requirements by structure, function, equipment, operations, occupancy, and weather. The algorithms are dynamic over time, reflecting changes in the building's energy math, including incremental advances from code and standard changes and business refurbishment cycles.

With 25-40% meter-specific energy reductions, efficiency as energy is a new resource and asset category. The energy savings are used as to create new transaction structure opportunities to attract the capital markets to invest in building efficiency over 20-30 years. Ongoing calibration of dynamic baselines and comparison to metered load gives a measure of efficiency persistence.

- Significant efficiency savings create significant value: The market value is the difference between the dynamic baseline and the metered load.
- Significant value attracts investment capital that's needed to scale efficiency properly.
- Significant efficiency as energy provides benefits to building owners and tenants alike.

A new energy source, efficiency can be invested in over long periods of time (perhaps decades) as a new resource asset type, with flexible load management and reliability measurements.[xxxiii] California utilities could invest in efficiency, alone or bundled with other distributed resources. Transactions structures can be designed to bill the building at the energy usage up to (or less than) the

dynamic baseline. The difference between the dynamic baseline and metered bill is used to recoup efficiency investment costs, with possible additional bill saving benefits shared with building owners and tenants. This holds the potential to turn efficiency savings into energy yield:

EE = Energy,

not just operationally, but transactionally, in both markets for both energy and capital.

Dynamic Baselines 101

Here are the fundamental steps needed to establish a real-time, credible relationship between the dynamic baseline for savings and actual metered savings:

(1) Create building energy and load profiles out of historic and current building metered data. Develop algorithms that identify building load by structure, function, usage, occupancy, and weather. The algorithms are dynamic over time, reflecting changes in the building's energy math, including incremental advances from code and standard changes and business refurbishment cycles
(2) Develop business plan for building efficiency to reduce energy and load by 25-40% over five years. Needed: Audit, engineering plan, finance and investment, and contracting plans; building owner and tenant agreements.
(3) Execute 1 and 2.
(4) Run comparison dynamic baseline and meter bill. Run dynamic baseline as metered data through the appropriate tariff(s), and calculate dynamic baseline energy bill.
(5) Compare to meter energy bill. This is the value of efficiency as an energy asset.
(6) Keep going! Keep investing! Keep saving!

Energy efficiency, bundled with other distributed energy resources, can be a new utility resource and asset type, with flexible load management and reliable measurements.

Recently a group associated with the Bullitt Foundation, Seattle City Light, the Northwest Energy Efficiency Alliance, Equilibrium Capital Group, and the New Building Institute has pioneered a new analytic framework and toolset for distributed energy resources Equilibrium Capital offers a transaction structure that uses EnergyRM's dynamic baseline "DeltaMeter",[xxxiv] called MEETS – the Metered Energy Efficiency Transaction Structure.[xxxv]

MEETS is to incentive-based energy efficiency as a solar feed in tariff (or other form of solar PPA) is to solar net metering. MEETS uses the DeltaMeter's dynamic baseline meter function to measure and sell the entire yield of energy and energy attributes from efficiency installed in a facility, back to the utility in a long-term PPA.

The possibilities of using dynamic baseline metering to open up new transaction structures for deep investment, and persistence of savings, are compelling.

Demonstrating DR-enabled HVAC, with Energy Efficiency

Residential commercial space cooling loads (HVAC) provide a perfect opportunity to take a more holistic view of a series of capacity, energy and grid reliability needs. HVAC is more than just an energy-saving opportunity. Space cooling load drives California's peak, generation, and T&D capital costs, and often local capacity and reliability constraints.

Residential and commercial space cooling is the single most important end use that, if done robustly, can integrate efficiency, peak demand reductions, demand response, and energy storage (commercial), while having a major impact on climate and air quality goals. This will be all the more valuable in local constrained regions.

Utility efficiency programs have tended to focus on higher efficiency cooling equipment. Managing the entire building as a system to reduce cooling load is equally important. All building energy turns to heat – which must be shed. Efficient design of all other energy systems in the building is therefore also space cooling, as it reduces internal heat load. The whole entire building as a system should allow proper sizing and other elements of quality installation and maintenance of HVAC equipment, effective air handling, timing effects of heat-generating loads of other kinds, and use of DR-enabling, storage and/or other peak-flattening new technologies.

Lacking a systems approach results in poor design and installation choices that in turn lead to increased consumption and even more internal heat load that needs to be shed, often at time of local distribution peaks and critical peaks. The combination is a pernicious problem throughout the residential and commercial HVAC industry. As a result, California today is far from the CPUC's 2007 long term strategic goal to "reshape residential and small commercial HVAC to ensure optimal equipment performance" with initiative targets of a 50% percent improvement in efficiency in the HVAC sector by 2020, and a 75 % improvement by 2030.[xxxvi]

Unfortunately, in SoCal existing commercial HVAC units are now being replaced with higher efficiency units before burnout as part of as an "early retirement" (ER) program that does not involve DR-enabled capabilities, down-sizing of equipment tonnage via improved air handling, building commissioning, or reductions in lighting and other internal heat-generating loads. The beauty of a well-designed early retirement (ER) program is that it can buy time to get HVAC installations "right," absent the time pressure often associated with HVAC replacement on burnout (ROB). All considered, SoCal HVAC early retirement is likely locking in greater HVAC inefficiencies for a longer period of time than would be the case if there were more thoughtful EE program intervention.

Replacing HVAC equipment (ER or ROB) without taking advantage of the optimization opportunity from proper systems redesign and buildings operations practices – most particularly resulting in reducing equipment tonnage sizing enabled by reduced absolute heating load from holistic

"whole building" thinking – contributes to an ongoing brittle distribution grid. Increasing temperatures lead to potentially more "summer heat storm" conditions, with concurrent hot days increasing the air conditioning demand disproportionately as stored heat builds up in building mass. Oversized (excess tonnage) HVAC equipment—underused or "idle" under normal cooling conditions—kicks into high gear during extreme heat conditions, driving additional spikes in local area distribution loads and potential brownouts- and blackouts. The result: distribution "angioplasty" in the form of often hasty and avoidable infrastructure expansions, and upward pressure on the state's utility distribution investment, now nearly $6 billion annually.[xxxvii]

There is also little concerted activity in SoCal to address residential space-cooling loads, with apparent disregard for the wealth of information and data showing residential HVAC loads highly correlated to system and distribution peak load requirements.[xxxviii] This leaves the impression that in-state energy efficiency operates under a code of "*even if all else fails, don't save energy on peak via residential HVAC.*" This approach results in utility distribution investment plans that are unnecessarily overbuilt to meet inefficiently sized and operated HVAC to meet peak loads.[xxxix]

IV. Conclusion

The imperative for change is compelling and immediate. Energy efficiency, bundled with DR, ES, and DG as distributed energy resources, can be a new utility resource and asset type, with flexible load management and reliable measurements. California needs new transaction structures that move beyond consumers' limited investment horizons to more intelligent energy efficiency; that will lead, in turn, to lower utility costs and lower cost of utility capital formation.

California will need its distribution grid for a long time to come. But if it fails to take advantage of energy efficiency that exists in abundance it will bring upon itself the claim that, as it has been managed, the grid is too expensive. Customers will be inclined to seek bypass options, whether through self-supply or microgrids.[xl]

California needs a smart grid. But a grid cannot be smart if it fails to take advantage of the lowest cost options to provide reliable service. Such a grid would be the opposite of smart. You know the word. ■

Endnotes:

[i] McKinsey & Company, *Unlocking Energy Efficiency in the U.S. Economy*, July 2009.

[ii] The international investment banking firm Lazard recently published an analysis of the comparative costs of a wide range of resources, ""LAZARD'S LEVELIZED COST OF ENERGY ANALYSIS — VERSION 8.0." Energy efficiency exceeded all others by a wide margin.

[iii] See Edison Electric Institute's (EEI) "Disruptive Challenges: Financial Implications and Strategic Responses to a Changing Retail Electric Business", January 2013. "Disruptive Challenges" frames DER as a direct threat to the centralized utility business model that should be addressed in part by revising tariffs structures to increase fixed charge or demand charge service components, repeal of net metering, changes to deprecation recovery lives, stranded cost charges, construction work in progress (CWIP), increased allowed cost of capital. At the end of the document (p. 18), the door is opened to a possible strategic opportunity for the industry to realize growth in earnings by "develop[ing] profit streams to counterbalance the impact of disruptive forces. Examples of new profit sources would include ownership of distributed resources with the receipt of an ongoing service fee or rate basing the investment and financial incentives for utilities to encourage demand side/energy efficiency benefits for customers." (Emphasis added.)

[iv] In California, the utilities total income available for common stock (after expenses and taxes) was about $2.5 – 3.0 billion annually 2010-2012. The incentives paid to utility shareholders for utility EE programs of $212 million (2006-2008) was only about 2.3 to 2.8% of utility total income.

[v] "Critical Thinking on California IOU Energy Efficiency Performance Incentives from a Consumer Advocate's Perspective", *William B. Marcus, JBS Energy, Inc. and* Cynthia *K. Mitchell, Energy Economics, Inc.,* presented to American Council for an Energy Efficient Economy (ACEEE) Summer Study on Energy Efficiency in Buildings Asilomar Conference Center, Pacific Grove, California, August, 2006, pgs. 6-7.

"Revenue true-up mechanisms such as the former Electric Revenue Adjustment Mechanism (ERAM) (and the new proliferation of California balancing accounts that accomplish the same thing) do not change the underlying basis of the IOUs' business model. ERAM addresses the short run (between rate case) requirement that revenues from electricity sales be sufficient to recover, but not exceed, the regulatory allowed cost of current capital investments. A stable or increasing sales base is paramount to the IOUs' corporate business model because it is the critical driver for recurring capital-intensive investments in a combination of replacement and/or expansion of aging infrastructure, and the addition of new generation, transmission and distribution facilities, which are largely driven by peak load increases. The costs of new "steel in the ground" projects are included in periodic rate case filings where increases in allowed revenues are accompanied by upward adjustments to historic sales data. ERAM does not dissolve the underlying truth that sales growth - be it kilowatt-hours or widgets - is what makes the world go 'round for the capitalist business model.

Thus, ERAM alone may actually provide long-term incentives to reduce EE program effectiveness (particularly in peak demand periods) to promote capital spending.

[vi] CPUC Commissioner Michel Florio, public comments at the "The Business Model for the Electric Utility of the Future: CPUC En Banc", October 8, 2013: "California faces magnitudes of change in energy-related climate impacts and local reliability that are much bigger going forward than even the past five years. Where is the sense of urgency?" And, "We need to align the utility

business model with sustainability. We are going to need a grid for a real long time here."

[vii] CEC Chairman Dr. Robert Weisenmiller at the August 20, 2014 CEC Integrated Energy Plan Report (IEPR) Lead Commissioner Workshop: Southern California Electricity Reliability, opening comments stated in part that (paraphrased) "California faces a pretty heavy lift here. The last two summers we have had a fairly reliable system, in part because it was been cooler than average. We have used quick fixes so far and do not have too many band-aids left. This is not a time for complacency. This summer has been hotter than average, with about 300 fires a week now, and the worst drought in history. 96% of California is in high fire risk and the state is moving into peak fire season in Southern California September and October."

[viii] CA's decades old approach to EE is largely a "regulatory compliance function with utilities an implementing partner with government on state policies". September 2013 conversation with Gene Rodrigues, former Senior Director of Demand Side Management Strategy for Southern California Edison (23 years), now Vice President, ICF International.

[ix] Energy efficiency cost effectiveness determined based on the value of the avoided energy costs over the *measure* life.

[x] One indicator is that California forecasts twice as much economic EE potential relative to what is being as being deemed market achievable. CPUC "2013 California Energy Efficiency Potential and Goals Study: Revised Draft Report", Navigant Consulting, November 26, 2013, Figure ES-2. Comparison of Technical, Economic, and Cumulative Market Potential in the 2011 and 2013 Studies. www.cpuc.ca.gov. The difference between economic and market potential is on average about 30,000 GWh over the forecast period 2012-2024.

[xi] McKinsey & Company, Unlocking Energy Efficiency in the US Economy, 2009, summarized experience across the US. Residential customers require a 2 to 3 year payback (McKinsey at 9) while commercial customers require a 3.6 year payback (McKinsey at 58) and industrial sites 18 months to three years (McKinsey at 81.)

[xii] Joint Agencies (CEC, CA ISO, CPUC) February 25, 2013 response to Senator Padilla and Fuller, the Chair and Vice Chair of CA State Senate Committee on Energy, Utilities, and Communications, regarding the development of joint energy agency recommendations to further CA's goal of reducing the need for new power plants by investing in EE. Response to Question 2, Page 3.

[xiii] Section II. CA historic EE accomplishments, was reviewed and deemed a reasonably factual characterization accurate by Chris Kavalec, CEC Demand Forecaster.

[xiv] U.S. Energy Secretary Steven Chu attributes California's savings to its "progressive energy policies". Steven Chu interviewed by Larry Klein and published in NOVA Online January 20, 2009. www.pbs.org/wgbh/nova/tech/energy-secretary-chu.html

Al Gore, "Our Choice: A Plan to Solve the Climate Crisis", 2009. P. 247-248.

> "One state that did not lose its focus on efficiency was California. Art Rosenfeld, the state energy commissioner who designed California's efficiency initiative, points out that energy use in his state had increased rapidly from the end of World War II until the first oil embargo in 1973, just as it had in the rest of the country. However, in the past three decades, California's total per capita electricity consumption has not increased at all, even though its per capita economic output almost doubled. Meanwhile, in the rest of the nation, per capita electricity use increased by more than 60 percent over the same period, with virtually the same economic-output gains."

Thomas Friedman in "Hot, Flat and Crowded' 2008 , at 278-279:

> "After the 1973–74 oil price shock, California began instituting the highest efficiency standards of any state in the country for buildings and appliances, like refrigerators and air conditioners. The net result: Per capita electricity consumption in California has stayed almost flat for the past thirty years, even though the state's economy has vastly expanded. The per capita electricity consumption in the rest of the country during this same period is up 50 percent, according to a study by NRDC. If California's energy use had grown at the same rate as that of the rest of America's, says NRDC, about 25,000 additional megawatts' worth of new generating stations would have been needed—roughly equivalent to fifty large 500-megawatt power plants. "

Time Magazine January and November 2009, The Economist May 2008 and January 2007, and Scientific American September 2005, all cite California's success in saving electricity and reducing / stabilizing per capita electricity consumption.

California's regulatory system has shared this view. California Public Utilities Commission and *California Energy Commission, "Energy Efficiency: California's Highest-Priority Resource" June 2006:*

> "The highest-profile piece of evidence for the efficacy of California's energy policy is a simple comparison of electricity consumption per capita in California and other states. Because of its energy efficiency standards and program investments, electricity use per person in California has remained relatively stable over the past 30 years, while nationwide electricity use has increased."

See similar current statements CEC Integrated Energy Policy Report (IEPR), p. 2, CEC-100-2013-001-CMF, and California Air Resources Board (CARB) First Update to the Climate Change Scoping Plan Building on the Framework Pursuant to AB32 The California Global Warming Solutions Act of 2006, May 2014, Chapter 1, p. 2.

[xv]Sudarshan, A and Sweeny, J, "Deconstructing the 'Rosenfeld Curve'", Precourt Institute for Energy Efficiency, Stanford University, June 2008. http://piee.stanford.edu/cgi-bin/docs/publications/Deconstructing_the_Rosenfeld_Curve.pdf (Analysis examining the extent to which factors other than EE programs could have contributed to the stabilization of CA's electricity per capita consumption, concluding that only around a quarter of the difference between the US and CA could be attributed to EE programs.)

[xvi]Mitchell, C, et al "Stabilizing CA's Demand: The real reasons behind the state's energy savings", Public Utilities Fortnightly, March 2009 (*hereinafter "C. Mitchell*). Linear regression analysis of CA historic (1976-2003) claimed EE savings to CA per capita electricity use showed a relationship between these two variables of less than 20%. Other factors contributing to CA's different consumption trend included price of electricity, climate, household size, housing mix, conservation ethic, and structural changes over time in the economy to a less energy intensive industrial mix.

[xvii]Levinson, A., California energy efficiency: Lessons for the rest of the world, or not? J. Econ. Behav. Organ. (2014), http://dx.doi.org/10.1016/j.jebo.2014.04.014. Levinson demonstrates that differences in climate and demographics account for almost 90 percent of the difference between California's and other states' residential electricity use. The article notes that EE laws similar to those in California have been adopted by many states and the federal government, and if all those laws worked they would have slowed electricity consumption everywhere, not just in California.

C. Mitchell 2009 (p. 56; ft. 25) analysis also examined the historic claimed EE savings, particularly for the initial 10 year period 1976-1985 of 20,000 GWh or one-third of CA's total reported cumulative EE savings. p. 56.

Importantly, for the CEC's 2009 Integrated Energy Policy Report (IEPR), CEC Staff categorized most of the 20,000 GWh of EE savings for the 1976-1997 period as price-induced

conservation effects, with the percentage of EE claimed savings included in the 2009 IEPR very low, averaging about 7 to 15%. See CEC Staff Report "Efficiency Programs: Incorporating Historical Activities Into Energy Commission Demand Forecasts", May 2001 CEC-200-2011-005-SD, p. 8. (Emphasis added.)

CEC Staff explains "This discounting was part of staff's effort to develop a realistic back-cast relative to actual historic energy consumption in the commercial and residential sectors. In staff's judgment at the time, actual reductions in consumption from programs, after accounting for standards, price effects, and other factors, were nowhere near the amount of savings claimed. The reported estimates were prepared with due diligence, but the estimates were made before reliable evaluation techniques and reporting requirements were developed. More specifically, Energy Commission staff typically excluded information and education programs, since there was no basis for concrete estimates of consumption decline from these mechanisms. These activities in particular have little long-term measured and verified savings associated with them." (pgs. 9-10)

[xviii] For instance, The Natural Resources Defense Council (NRDC) Fact Sheet March 2014 "Scaling Up CA's EE to Save Money and Reduce Pollution" claims purported CA EE savings since 1974 of 15,000 MW are the equivalent to thirty 500 MW power plants. This overlooks the California Energy Commission (CEC) adjustment to the historic data from 1974 to 1997, eliminating about 90% of the 15,000 MW of NRDC-claimed EE savings from the CEC Demand Forecast, or about one-third of the total current cumulative savings. To equate CA's more recent historic EE savings, built in part on short-lived EE measures such as compact and linear fluorescent lamps, to 500 MW power plants is misleading http://switchboard.nrdc.org/blogs/lettenson/. See also December 23, 2013 blog with link to NRDC July 2013 Fact Sheet CA EE Success Story.

[xix] Assumptions include existing energy use conditions, the efficiency of EE measures, installation rates, installation quality, operational performance, maintenance practices, building occupancy and usage characteristics, durability and persistence, code and standard effects, and business refurbishment cycles.

[xx] The CPUC's 2006-2008 EE Evaluation Report prepared by the Energy Division dated July 2010 adjusted utility claimed EE GWh energy and MW demand savings downward by about 40%. www.cpuc.ca.gov/. These are the most recent period Energy Division independent evaluation published results. Subsequent evaluations are most likely to show the difference between utility claimed savings to CPUC independent evaluation results narrowing.

[xxi] Even if all negawatts created from energy efficiency help reduce overall system-wide demand, they do not necessarily reduce demand at the time or location of peak demand. Thus, when it comes to determining whether new power plants are needed to meet energy needs, it may be that not all negawatts are created equal." The California State Senate Committee of Energy, Utilities, and Communications, Informational Hearing, January 28, 2013, White Paper "Energy Efficiency: All Negawatts Are Created Equal, But Some are More Equal Than Others", pgs. 1-2.

[xxii] "Demand Response and Energy Efficiency Roadmap: Maximizing Preferred Resources", CA ISO, December, p. 8. "The CAISO monitors on a continuous metered basis the location, occurrence and duration of load and energy requirements. The CAISO considers resources as either supply-side or load-modifiers. Per the CAISO, supply-side resources are those energy supplies available to the CAISO to balance net load. Load-modifiers are those resources or programs not see or optimized by the CAISO market, but they modify the fundamental system load shape, preferably in ways that harmonize with ISO grid operations. As such, CA's preferred resources of EE, DR, ES, rooftop solar, and DG, are a mix of both supply-side and load-modifier resources. Because the location, occurrence, and duration, of demand

response, roof top solar, and distributed generation is often traceable to specific circuits and meters, the CAISO can more readily consider these demand-side resources as grid reliable. EE's contribution to local grid reliability is less clear given the difficulties in more accurately monitoring and measuring EE." (Emphasis added.)

[xxiii]California Legislative Analyst's Office (LAO), "Energy Efficiency and Alternative Energy Programs", December 19, 2012. 2002-20113 EE program spending $9.5 Billion.

CEC Draft Staff Report "California Energy Demand 2014-2024 Revised Forecast", CEC Figures Statewide Baseline Annual Electricity Consumption, Consumption Per Capita, September 2013, CEC-200-2013-004-SD-V1-REV.

[xxiv] State of California Energy Action Plan 2008 Update. "The most important tool for addressing greenhouse gas emissions in the energy sector is energy efficiency." (p. 6) "While this stabilization of per capita electricity use is something we are proud of, it is not nearly enough to meet our AB 32 goals. To address this emissions reduction challenge for electricity, we will need to bend this curve downward, because, among other reasons, the population of California continues to grow rapidly, causing overall electricity use in the state to continue to rise by between one and two percent every year." (p. 7) "Finally, with the population and economic growth occurring in California, it simply will not be enough to be more efficient with energy use. We actually need to reduce overall energy use." (p. 8) (emphasis added.www.energy.ca.gov/2008publications/

[xxv] In 2005, Executive Order S-3-05 drew on concerns about the impact of climate change on California and referenced the state's existing leadership role in reducing GHG emissions. The EO and codifying 2006 Assembly Bill (AB) 32 established three targets: http://www.dot.ca.gov/hq/energy/ExecOrderS-3-05.htm

- Reduce GHG emissions to 2000 levels by 2010
- Reduce GHG emissions to 1990 levels by 2020

Reduce GHG emissions to 80% below 1990 levels by 2050.

[xxvi] The load factor varies with temperature; in years with extreme heat (1998, 2006), demand is "peakier", which results in lower system load factors.

CEC Draft Staff Report "California Energy Demand 2014-2014 Revised Forecast", CEC Figures 1 – 3 and 5, Statewide Baseline Annual Electricity Consumption, Consumption Per Capita, Noncoincident Peak Demand, and Noncoincident Peak Demand Per Capita, and 4: Statewide Baseline Noncoincident Peak Load Factors. September 2013, CEC-200-2013-004-SD-V1-REV.

[xxvii] CA noncoincident peak demand ("peak demand") is increasing at a greater rate than annual consumption, with a projected average annual growth of 1.83% from 2012-2024. Historical per capita peak demand has increased at a rate greater than per capita consumption, with this trend forecasted to continue through 2024. The CEC explains that this "reflects the continued increases in air conditioning usage. Conversely, system load factors have declined and are forecasted to continue to do so. The load factor varies with temperature; in years with extreme heat (1998, 2006), demand is "peakier", which results in lower system load factors. The general decline in the load factor over the last 20 years indicates a greater proportion of homes and business with central air conditioning."

[xxviii] California Energy Commission Staff memo to Commissioner John L. Geesman and Commissioner James D. Boyd, from Tom Gorin, Demand Analysis Office, October 4, 2005, Supplementary Information on Historic Load Factors.

[xxix] CEC-500-2012-057, July 2012 "Estimating Risk to CA Energy Infrastructure From Projected Climate Change", p. 38.

[xxx] Michael Jaske, Ph.D, CEC Electricity Supply Analysis Division, "Overview of Southern California Electricity Infrastructure Issues", Joint CEC/CPUC Workshop Electricity Infrastructure Issues Resulting from SONGS Closure, July 15, 2013. The unique influence of SONGs includes: located within local reliability area; integral to system stability at the interface between SCE and SDG&E systems, especially voltage stability; SONGs retirement has greater impacts on SDG&E and southern Orange County than SCE as a whole; produced baseload energy with an average 82% annual capacity factor for 2001-2011. There have been a number of infrastructure assessments (local reliability for transmission constrained areas, system stability (voltage/frequency), system operating flexibility, system/zonal capacity balance.) http://www.energy.ca.gov/2013_energypolicy/documents/2013-07-15_workshop/presentations/

[xxxi] The California Public Utilities Commission (CPUC) in Decision 14-03-004 dated March 13, 2014, unanimously approved a plan to replace the shuttered San Onofre Nuclear Generating System (SONGS). The CPUC's actions will offset the retirement of the 2,200 MW San Onofre Nuclear Generating Station, and nearly 5,900 MW of once-through cooling plants. The decision directs Southern California Edison (SCE) and San Diego Gas & Electric (SDG&E) to procure energy supplies, including those from preferred resources (such as renewable power, demand response resources, and energy efficiency) or energy storage to meet the state's energy needs. The most recent decision, combined with prior CPUC decisions, brings a total of between 1,900 and 2,500 MW to the Los Angeles Basin from SCE, up to 60 percent of which may come from preferred resources. SDG&E is required to procure at least 25 percent and up to 100 percent of new local capacity from preferred resources. SCE and SDG&E are required to procure at least 50 MW and 25 MW from energy storage, respectively.

November 5, 2014 SCE announced contract winners for its Local Capacity Requirement (LCR) RFO, a long-term plan to bring about 2,200 megawatts of grid resources on-line by 2022 to help the Los Angeles and Orange County regions make up for the closure of the San Onofre nuclear power plant. Gas fired generation awards total 1698 MW out of 2221 MW or 76%. Energy Storage largest DER element at 261 MW or 12%. EE 136 MW out of 2221 MW or 6%.

https://www.greentechmedia.com/articles/read/breaking-sce-announces-winners-of-energy-storage-contracts

[xxxii] McKinsey Report 2009 Ibid iii. See also "Improving the Energy Efficiency of Non-owner Occupied Commercial Buildings: Policy Options for Local Governments in Silicon Valley", Stanford University Public Policy Practicum, March 2012; "The Promise and Potential of Comprehensive Commercial Building Retrofit Programs", ACEEE, May 2014.

[xxxiii] The transition to smarter and more distributed systems will need an open architecture market structure of location-specific information, price, control signals, costs, and performance risks: two-way transactions across the customer meter. In this construct, sites house both customers and developers of energy and capacity. As customers, they don't exist to generate "negawatts", rather "negawatts" are one way to service their demand. They may also build, or allow a third party or the utility to build, EE or other DR on their site – but that role is not a customer function, it's an energy developer function. The same party can fill both, but they need to be understood separately.

[xxxiv] EnergyRM's DeltaMeter™ (ref: www.en-rm.com.) The DeltaMeter is commercially available as a service, but any meter service capable of meeting the same spec is a dynamic baseline meter. Generally to meet the spec, it needs to be capable of detecting change from projected actual, categorizing that change correctly, using the categorization to calibrate the historic baseline if necessary, and capable of establishing and maintaining operational use, code, and load management baselines. The DeltaMeter system for doing this is patented, but other approaches may well achieve the same ends. What matters is the functional specification.

[xxxv] MEETS is designed to operate as an industry standard solution, and is not proprietary. Its designers elected to "membership open source" it to enable everyone to gain the benefit of discoveries, and so scale it quickly, an effort organized through

the "MEETS accelerator coalition" - www.MEETScoalition.org.

[xxxvi] CPUC "CA Long-Term Energy Efficiency Strategic Plan", September 2008, detailing one of the "Big/Bold Strategies" adopted by the CPUC in October 2007.

"California law requires contractors to obtain a permit for the installation of new HVAC equipment (including replacements of existing equipment) and to perform quality control checks. Yet fewer than 10 percent of contractors obtain such permits, perform quality control checks, or have their work verified by third-party raters. Failure to ensure quality at the time of cooling system installations results in a 20 to 30 percent increase in the peak energy needed by systems. This problem is exacerbated by Title 24 provisions that allow optional compliance with HVAC quality control requirements; a contractor may install higher efficiency measures in a new building in lieu of the quality installation and control requirements, absent any performance verification. The Air Conditioning Contractors of America (ACCA) recently developed a quality installation (QI) specification for air conditioning equipment that has become an American National Standards Institute (ANSI) standard. It is comprehensive, addressing all aspects of HVAC quality installation, including equipment, installation and ducts. The Energy Commission's June 2008 HVAC report recommended that the Energy Commission consider making the ACCA or similar requirements mandatory for all HVAC installations, in lieu of Title 24's current optional requirement. Energy Commission action to change its optional standards to mandatory quality control provisions is critical."

"Changing the status quo will require significant effort, since contractors who comply with HVAC code provisions incur higher costs that are difficult to pass onto customers in a highly competitive market.

Such contractors may also experience delays due to local government permit timelines. Local building officials may not have the resources or knowledge to establish streamlined permitting systems to support." quality HVAC installations or penalize contractors who do not comply." (Emphasis added).

See CPUC "HVAC Impact Evaluation Draft Report: WO32 HVAC – Volume I: Report", August 27, 2014, evaluating the 2010-2012 IOU statewide and Third Party commercial and residential HVAC programs: Quality Maintenance (QM), Quality Installation (QI), and Upstream Equipment Incentives. Statewide QM measures had a zero to negative "realization rate" (EE savings). The quality installation field assessments focused on residential systems because non-residential programs were not in full operation in 2010-2012. The overall gross realization rates were 35% for electric energy savings and 38% for demand savings after program effect savings relative to pre-program estimated savings.

[xxxvii] CPUC Rulemaking dated August 8, 2014, opened to establish policies, procedures, and rules to guide CA electric IOUs in developing their Distribution Resources Plan Proposals. Appendix B. "More Than Smart: A Framework to Make the Distribution Grid More Open, Efficient and Resilient", page 3

[xxxviii] In SCE 2015 EE Funding Request, March 26, 2014, p. 18, is the following statement "the residential sector is not a driver of peak demand." In the filing, Edison states that because there are a significant number of residential customers in the Johanna-Santiago area, it proposes to increase plug load appliance incentives, appliance recycling incentives, target pool pump replacement efforts, emphasize the MF EE program, and shift lighting recycling events to the region. Notably absent to this list is residential HVAC EE.

[xxxix] CPUC "CA Long-Term Energy Efficiency Strategic Plan", September 2008, detailing one of the "Big/Bold Strategies" adopted by the CPUC in October 2007. "By 2006, peak demand for residential air conditioning units was 14,316 MW. When small commercial air conditioning is added to the residential share, air conditioning loads cause over 30 percent of California's total peak power demand in the summer—with an enormous and costly impact on the need for generation, transmission, and distribution resources and a concurrent lowering of utility load factors." (p. 57).

[xl] "What if utilities had gotten ahead of the curve and seen the opportunity in distributed energy?", Jeff Navin, energy consultant, High Country News, "Solar City," January 20, 2014.

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