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Graphs, Words, and Deeds

Reflections on Commissioner Rosenfeld and California's Energy Efficiency Leadership

Innovations Case Discussion:
The California Effect

Late in 2006, soon after Governor Arnold Schwarzenegger signed into law California's path-breaking curbs on greenhouse gas emissions, a reporter asked California Energy Commissioner Arthur Rosenfeld when statewide reductions would start showing up. "Around 1975," he replied.

Showing how right he was would require an entire treatise, and happily a most compelling edition is already available to the public at no charge. In addition to the energy-efficiency achievements recounted in Commissioner Rosenfeld's article, a recently compiled *Green Innovation Index* adds five more California distinctions:

- Greenhouse gas emissions per capita, and greenhouse gas emissions per dollar of economic output, are less than half the average for the rest of the nation.
- California increased its renewable electricity production by 24 percent from 2003 to 2007.
- The state is home to 60 percent of U.S. venture capital investment in "clean technology" companies. (Californians also captured almost 40 percent of all U.S. solar energy patents from 2002 to 2007.)
- It has the fifth-lowest electricity cost, measured as a fraction of the state's economy, in the United States.
- Its residential gas and electric bills are well below the national average.[1]

A study at the University of California Berkeley, supplementing the index, also concluded that California's comparative advantage in energy efficiency had generated some $56 billion in net economic benefits since 1972, yielding an employment dividend of 1.5 million jobs.[2] And MIT's Energy Innovation initiative independently ranked California first among the states in sustained progress since 1980 in reducing residential sector energy use.[3]

Some maintain that California has championed efficiency at the expense of its economy, and that its low energy consumption is primarily a function of high elec-

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tricity rates.[4] However, as a fraction of its economy, California's electricity bill is one-third lower than the national average and just over half that of Texas and Florida (the disparity between California's and Texas's electric bill, in relative terms, represents a $25 billion/year comparative advantage for California).[5]

Can this be explained by state-specific economic or geophysical anomalies? While California indeed looks different from the rest of the country in some important respects, these contrasts generally are not new and do not explain significant sustained divergences in consumption trends between California and most other states over the decades encompassed by what some term "the California Effect" or "the Rosenfeld Effect."

Over more than three decades, compared with averages for the rest of the nation, significant differences have emerged in how Californians manage their energy use. Although contributors include factors independent of energy policy, such as average household size,[6] few would dispute the enduring importance of integrating a three-part efficiency policy that involves utility incentives, government standards, and technology innovation. The results can be seen today in both the efficiency with which energy services are delivered and the behavior of those who use the services. For example, Californians are much more likely than their counterparts in other states to own and use programmable thermostats, or to shut off systems altogether when away from home.[7] California's efficiency regulators have been steadily tightening minimum standards for buildings and equipment, following a 30-year pattern that is illustrated clearly in Commissioner Rosenfeld's graph of trends in refrigerator efficiency. In their first quarter century, California's building and equipment standards saved the equivalent of a dozen 500-megawatt power plants.[8]

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An important part of the Rosenfeld Effect also involves the regulation and role of utilities. As of 2009, some states were still debating whether and on what terms to encourage utilities to invest in energy-efficiency improvements. Aggregate utility-initiated electricity savings nationwide totaled only about 0.3 percent of retail sales in 2008.[9] California's three major utilities achieved eight times this level of savings during that same year, reflecting a 150 percent increase in annual investments over four years (from $370 million in 2004 to $935 million in 2008). Over that same period, annual energy savings grew even faster (from 1,900 GWh in 2004

to 4,900 GWh in 2008). These programs continue to provide the cheapest resource available to meet California's energy needs, averaging two to three cents per kWh in 2008.[10] And in that year, California utilities accounted for about one-third of the entire U.S. industry's entire efficiency investments.[11] The net benefits provided annually to customers by the California energy efficiency programs increased 160 percent from 2004 to 2008, and the cumulative net benefits over that five-year period were about $5.6 billion.[12]

These achievements have venerable antecedents. More than 30 years ago, California's utility regulators understood that traditional utility regulation had to change in order to put energy efficiency opportunities on an equal footing with generation alternatives. Writing for the majority in a 1975 case addressing the revenue needs of the Pacific Gas and Electric Company, PUC Commissioner Leonard Ross anticipated issues that many states still wrestle with today:

> We regard conservation as the most important task facing utilities today. Continued growth of energy consumption at the rates we have known in the past would mean even higher rates for customers, multibillion dollar capital requirements for utilities, and unchecked proliferation of power plants . . . Reducing energy growth in an orderly, intelligent manner is the only long-term solution to the energy crisis.
>
> At present, the financial incentives for utilities are for increased sales, not for conservation. Whatever conservation efforts utilities undertake are the result of good citizenship, rather than profit motivation. We applaud these efforts, but we think the task will be better accomplished if financial and civic motivations were not at cross purposes.
>
> The effort we expect is not limited to exhortation, advertising and traditional means of promoting conservation. We expect utilities to explore all possible cost-effective means of conservation, including intensive advisory programs directed at large customers, conservation-oriented research and development, [and] subsidy programs for capital-intensive conservation measures.[13]

Although few if any state utility regulators contest the objective of substituting less costly energy-efficiency savings for more costly alternative energy supplies, most utilities still automatically incur financial harm when electricity and natural gas use decline, and most utilities still are denied any earnings opportunities if they make cost-effective efficiency investments. The result is a broken business model: utilities typically suffer immediate losses with no prospect of gain if they try to help their customers achieve cost-effective energy savings, through either targeted incentives or improved government efficiency standards.

Commissioner Ross and his successors long ago grasped the need to prevent changes in customers' energy use from negatively affecting utilities' financial health. Much of a typical utility's cost of serving customers is independent of energy use (e.g., paying for generation, transmission, and distribution equipment

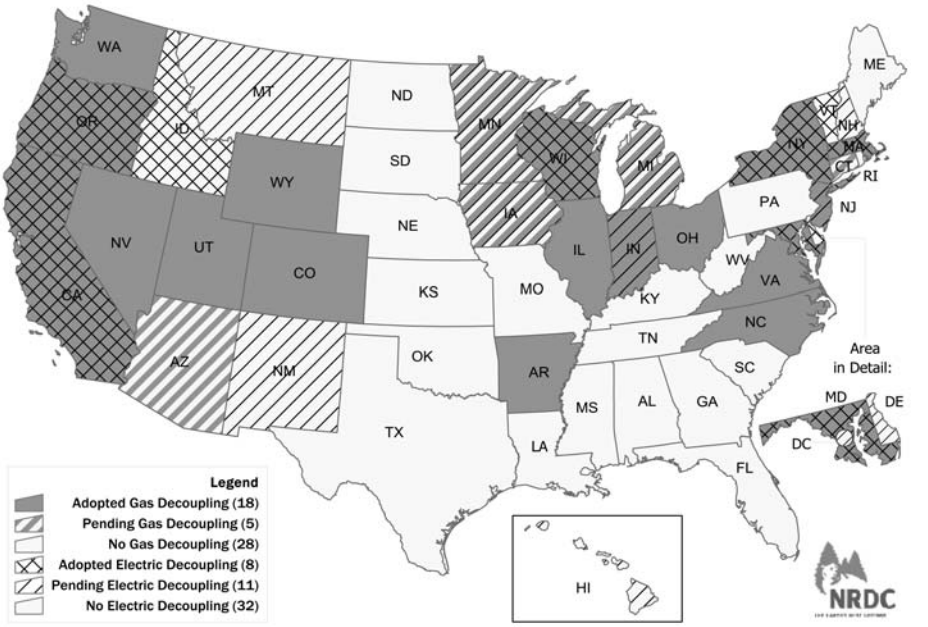

Figure 1. Gas and Electric Decoupling in the US (August 2009).
Source: Natural Resources Defense Council.

already installed). Since utilities recover most of their fixed costs of service through charges on electricity and natural gas use, increases or reductions in consumption will affect fixed cost recovery, even though the costs themselves don't change. Fixing this problem includes making sure that fluctuations in sales (either up or down) do not result in over- or under-recovery of utilities' previously approved fixed costs; otherwise utilities and their customers have automatically conflicting interests on even the most cost-effective energy efficiency.

The immediate temptation is to respond by converting fixed costs into fixed charges; this would make the recovery of fixed costs independent of energy sales, but it also would significantly reduce customers' rewards for reducing energy use. That is a step in the direction of what might be termed "all you can eat" rates, which reduce or eliminate customers' rewards for saving energy by making the bill largely independent of total energy consumption.

Some contend that recovering utilities' fixed costs as part of volumetric charges for electricity is inefficient, because it makes additional consumption look more costly than it should. That amounts to contending that most utilities today are suppressing beneficial increases in electricity and natural gas use through their rate designs. Yet the rationale for energy efficiency programs and standards rests in part on the conclusion that extensive market failures continue to block energy savings that are much cheaper than additional energy production at today's electricity

prices. What we need now is not rate designs that encourage electricity waste, but a strong move toward inverted rates, where the rule is "the more you use, the more you pay."

Of course, that means that utilities will go on relying on variable charges to recover all or most authorized fixed costs of service, which on the face of it creates a disincentive for utilities to promote energy efficiency. A straightforward solution, sometimes called "decoupling," is to use small, regular rate adjustments to prevent over- or under-recovery of authorized costs; the Appendix provides a detailed illustration. California had such mechanisms in place for both electric and natural gas utilities by 1982;[14] a nationwide debate is now underway over whether they should become the industry norm. As of October 2009, eighteen states had adopted decoupling mechanisms for one or more of their natural gas utilities; the comparable figure for electric utilities was eight states and the District of Columbia (see Figure 1.)

Although some have worried about the impact of decoupling on electricity and natural gas rates, industry experience shows minimal effects on short-term rates, and adjustments go in both directions. A comprehensive industry-wide assessment found that of 88 gas and electric rate adjustments since 2000 under decoupling mechanisms, only one-fifth involved increases exceeding 2 percent. Typical adjustments in utility bills "amount[ed] to less than $1.50 per month in higher or lower charges for residential gas customers and less than $2.00 per month . . . for residential electric customers."[15] That represents about a dime a day for the average household, which hardly seems like dangerous rate volatility, particularly since it sometimes comes in the form of a rebate—and serves only to ensure that the utility recovers no more and no less than the fixed costs of service that regulators have reviewed and approved.

These simple automatic adjustments eliminate a huge financial disincentive, but they do not by themselves give utilities an opportunity to share in the net benefits of cost-effective energy efficiency investments. It's good not to lose money automatically when you help your customers save energy, but it's even better from the perspectives of both shareholder and society if management has a financial incentive to succeed. To sustain their excellence in efficiency, investor-owned utilities, which deliver three-quarters of the nation's electricity and almost all of its natural gas, need more than just a guarantee against instant pain. California is one of about a dozen states that have responded with assurances that independently verified net energy efficiency savings to customers will also yield a reward for shareholders (see Appendix for illustrative operational details).[16]

The huge federal "stimulus bill" enacted in February 2009 includes an effort to encourage accelerated progress in utility regulatory reform. In Section 410 of the American Recovery and Reinvestment Act (ARRA), Congress appropriated $3.1 billion for state energy grants, to be released "only if the governor of the recipient state notifies the Secretary of Energy in writing that the governor has obtained necessary assurances" from that state's utility regulators that they will "seek to

implement" two conditions for gas and electric utilities over which they have regulatory authority:

- "A general policy that ensures that utility financial incentives are aligned with helping their customers use energy more efficiently;"
- "[T]imely cost recovery and a timely earnings opportunity for utilities associated with cost-effective measurable and verifiable savings."

In addition, these objectives are to be achieved "in a way that sustains or enhances utility customers' incentives to use energy more efficiently." And "to the extent practicable," utilities and their regulators are to be leaders in the ARRA implementation process. These provisions received broad support from environmental and business interests. Congress did not try to dictate ratemaking methodologies, beyond specifying that customers' incentives to save energy must not be impaired (ruling out the option of shifting fixed costs into fixed charges). And Congress did not try to impose final results on independent state regulatory commissions. Regulators in complying states certify only that they will "seek to implement" the conditions.[17] The ARRA conditions supply a strong nudge, not a straight-jacket. But states that want the benefits of accelerated energy efficiency progress now have added incentive to act swiftly.

For those who seek to suspend a dangerous global climate experiment while expanding global access to electricity services, California's precedents are of obvious and immediate interest. Many of America's leading physicists, business consultants, and environmental visionaries have recently reaffirmed a common theme: energy efficiency is the fastest, cheapest, and cleanest solution available for both overstressed power grids and an overtaxed atmosphere. Inexpensive ways to get more work out of less electricity are now understood worldwide as invaluable utility system resources, just like new power plants or enhanced distribution systems. Recent studies offer three particularly arresting conclusions:

- Energy efficiency measures in buildings and appliances could cut U.S. global warming pollution by almost a billion tons a year by 2030 (CO_2 equivalent, or more than one-eighth of total current U.S. greenhouse-gas emissions) at *negative cost* (McKinsey & Co.).[18]
- Energy demand from the entire U.S. buildings sector (everything from houses to light bulbs to office towers to retail stores) would not grow at all from 2008 to 2030 if we deployed energy efficiency measures costing less than the energy they displaced (American Physical Society).[19]
- Closing the electricity efficiency gap between the 10 top-performing states and the other 40 would achieve electricity savings equivalent to more than 60 percent of U.S. coal-fired generation (Rocky Mountain Institute).[20]

California's achievements make these projections more than hypothetical. Certainly the state has a gratifying number of fierce competitors, and its mission is hardly complete. Yet it remains the most fully realized effort to decarbonize an advanced economy in economically compelling ways. Precisely because its image is the antithesis of self-denial, California remains the most powerful rebuttal to

claims that greenhouse-gas reductions cannot be achieved without personal privation and economic decline. Long live the Rosenfeld Effect, and its indomitable progenitor.

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APPENDIX: HOW TO FIX THE UTILITY BUSINESS MODEL

I. Aligning Customer and Utility Incentives in Energy Efficiency

This illustration draws on the experience of the Idaho Power Company, Idaho's principal investor-owned electric utility.

- State utility regulators authorize recovery of $300 million in fixed costs for an electric utility over the next year and set its rates based on assumed electricity use for that period; those fixed costs represent half of the $600 million cost of providing service at that level of consumption, with the rest representing fuel and other variable costs.
- Despite energy efficiency efforts by the utility and its customers, retail electricity sales over the next year are one percent higher than regulators had anticipated, as a result of stronger than expected economic growth. Regulators respond by adjusting electric rates downward by just under half of one percent to return $3 million in excess cost recovery to the utility's customers ($3 million/$606 million).
- Or, alternatively, after one year, strong energy efficiency efforts by the utility and its customers and other factors push retail electricity use one percent below the level that regulators anticipated when rates were set. Regulators then adjust electric rates upward by just over one half of one percent to make the utility whole for $3 million in under-recovery of authorized fixed costs ($3 million/$594 million).
- An index (tied to inflation or customer growth or some combination) is used every year to adjust authorized fixed costs up or down, until the regulators have an opportunity in the utility's next adjudicated "rate case" to reassess the utility's revenue requirements for fixed-cost recovery and other purposes, with opportunities for all interested parties to participate. The regulators then approve a new authorized fixed-cost target, and the process begins again.

II. Providing a Performance-Based Earnings Opportunity

That same electric utility demonstrates through independent measurement and verification that its annual expenditure of $20 million to secure cost-effective energy efficiency savings by customers avoided an annual expenditure of $40 million on alternative energy supply resources.

- Regulators authorize recovery of the $20 million in energy efficiency costs and allow the utility to retain 10 percent of the $20 million in net savings to customers.
- Customers' annual utility bill drops by $18 million as a result of the utility's energy efficiency expenditures, notwithstanding the utility's timely cost recovery and its earnings opportunity.

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1 See Next 10, *California Green Technology Index* (2009), pp. 4 (emissions per person), 17 (emissions per dollar of economic output); 33 (patents); 64 (electricity costs). The *Index* is available in full at www.nextten.org/next10/publications/greenInnovation09.html. See also U.S. Energy Information Administration, "Average Monthly Bill for Residential Electric Utility Customers" (2008: www.eia.doe.gov/cneaf/electricity/esr/table5.xls), which pegs California's average residential electricity bill at $84.56, more than ten percent below the national average of $95.66. It also reports that the states with the nation's highest average residential electricity bills are Hawaii, Texas, and Florida; each exceeds the national average by more than 30 percent.

2. D. Roland-Holst, *Energy Efficiency, Innovation and Job Creation in California* (Next 10, October 2008), p. 3: "Energy efficiency measures have enabled California households to redirect their expenditure toward other goods and services, creating about 1.5 million FTE jobs with a total payroll of over $45 billion, driven by well-documented household energy savings of $56 billion from 1972-2006."
http://are.berkeley.edu/~dwrh/CERES_Web/Docs/UCB%20Energy%20Innovation%20and%20Job%20Creation%2010-20-08.pdf.

3. R. Lester, A. Finan, and R. Sakhuja, *The Role of Energy Efficiency in Reducing Climate Change Risks* (MIT Industrial Performance Center, March 2009), p. 11, compare states based on "annual change in residential delivered energy per capita, 1980-2006."

4. For example, K. Galbraith, in Deciphering California's Efficiency Successes (New York Times, April 14, 2009, Green Inc., http://greeninc.blogs.nytimes.com/2009/04/14/deciphering-californias-efficiency-successes) cites contentions that "California's electricity prices have risen far faster than those elsewhere."

5. See Next Ten, note 1 above, at p. 64.

6. "Larger households are able to attain economies of scale" in energy use "and California households on average now have about ten percent more occupants than the national average." A. Sudarshan and J. Sweeney, *Deconstructing the "Rosenfeld Curve"* (Precourt Institute for Energy Efficiency, Stanford University, June 2008), p. 7.

7. Sudarshan and Sweeney, p. 12.

8. California Energy Commission, *2005 Integrated Energy Policy Report* (CEC-100-2005-007), p. 70.

9. G. Barbose, C. Goldman and J. Schlegel, "The Shifting Landscape of Ratepayer-Funded Energy Efficiency in the U.S." (Ernest Orlando Lawrence Berkeley National Laboratory Report, October 2009), p. 1. The near-term trend is encouraging, however; combined utility investments in electricity and natural gas efficiency improvements increased by 20 percent in 2008. Ibid., p. 3.

10. I am indebted to my NRDC colleague James Chou for the data summarized in this paragraph, which he assembled in August 2009 from reports and data submissions by California's three major utilities. The 2 cents/kWh is calculated from utilities' total investments and total lifecycle savings. Utility-reported levelized cost is 3 cents/kWh. The difference is that the utility estimate discounts the costs and savings. The 2006-2008 figures are from utility annual reports posted on the PUC website (http://eega2006.cpuc.ca.gov/) and individual data requests from the utilities. Data from 2004 and 2005 were compiled by NRDC from PG&E, SCE and Sempra Utilities' Annual Earnings Assessment Proceedings (AEAP) at the California PUC.

11. Barbose, Goldman and Schlegel, in *The Shifting Landscape*, p. 3, credit California with $831 million of $2.6 billion in electric efficiency investment in 2008, and $183 million of $529 million in natural-gas efficiency investment.

12. Compiled by NRDC's James Chou from sources cited in note 11 above.
13. D. 84902 (September 16, 1975), quoted in B. Barkovitch, *Changing Strategies in Utility Regulation: The Case of Energy Conservation in California* (doctoral dissertation, University of California, 1987), pp. 134-35.
14. J. Eto, S. Stoft and T. Belden, The Theory and Practice of Decoupling (Lawrence Berkeley Laboratory, LBL-34555, January 1994), p. 21. The first formal decoupling proposal of which I am aware appears in testimony filed with the California Public Utilities Commission by William B. Marcus and Dian Grueneich (now a commissioner) in April 1981, as follows: "Total base revenues for forecast sales and base revenues resulting from actual sales would be compared on a quarterly basis. . . . The resulting undercollection or overcollection would be placed in a balancing account, rates would be adjusted to amortize the balancing account, and the balancing account would accrue interest at the prime rate." W. Marcus, California Energy Commission Staff Report on PG&E's Financial Needs, Application No. 60153 (April 21, 1981, Revised July 1981), p. 55.
15. P. Lesh, Rate *Impacts and Key Design Elements of Gas and Electric Utility Decoupling: A Comprehensive Review* (June 2009), p. 3. The report is posted on the website of the Regulatory Assistance Project, at http://www.raponline.org/showpdf.asp?PDF_URL=%22Pubs/Lesh-CompReviewDecouplingInfoElecandGas-30June09.pdf%22
16. See The Edison Foundation, Institute for Electric Efficiency, Performance Incentives for Energy Efficiency by State (May 2009), at www.edisonfoundation.net/iee/issueBriefs/IncentiveMechanisms_0509.pdf. For an admirably concise and compelling treatment of these issues for a mass audience, see T. Friedman, Hot, Flat and Crowded (2008), pp. 285-90.
17. Expressions of regulators' intent routinely launch a broad variety of utility proceedings; regulators' final decisions depend on weighing the views of all participating parties, applicable law and other factors.
18. McKinsey and Co., "Reducing U.S. Greenhouse Gas Emissions: How Much At What Cost?" www.mckinsey.com/clientservice/ccsi/greenhousegas.asp, pp. x-xiv. Assessment includes "lighting retrofits, improved heating, ventilation, air conditioning systems, building envelopes, and building control systems; [and] higher performance for consumer and office electronics and appliances."
19. American Physical Society, *Energy Future: Think Efficiency* (September 2008). www.aps.org/energyefficiencyreport/
20. Natalie Mims, Mathias Bell, and Stephen Doig, *Assessing the Electric Productivity Gap and the US Efficiency Opportunity* (Rocky Mountain Institute, February 2009). http://ert.rmi.org/files/documents/CGU.RMI.pdf.