

California Electricity: Facts, Myths, and National Lessons

Amory B. Lovins, ablovins@rmi.org
CEO (Research), Rocky Mountain Institute, www.rmi.org
[also Chairman, Hypercar Inc., www.hypercar.com]



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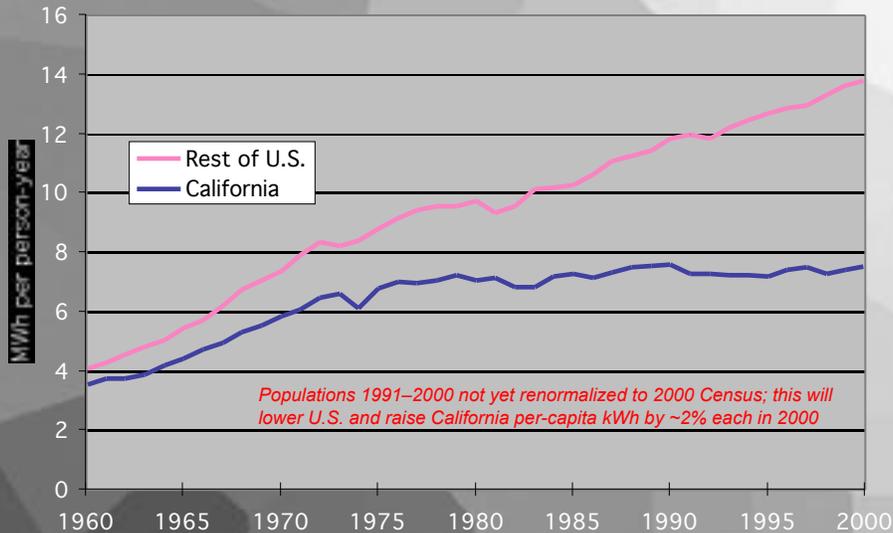
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Just the facts, ma'am... (if all else fails, consult the data)

- ***CA's electricity consumption did not soar, in Silicon Valley or anywhere else, due to the Internet or anything else***
- ***CA didn't stop building plants in the '90s***
- ***Reserves tightened but stayed adequate***
- ***CA has probably not been short of gen. capacity (at historic forced outage rates) during any of its power emergencies***
- ***CA and WSCC supply may already be in overshoot...before savings really ripen***

California: policy really does work

Per-capita electricity consumption, 1960–2000



California's electricity mess

- **Ideologues fixed a system that wasn't broken and that they didn't understand**
 - W Coast had vibrant wholesale mkt 1980–
 - CA had ample supply, reasonable/stable price
- **Gov. Wilson's goal to refinance nuclear debt with cheaper public debt was sweetened with consumer & envtl. goodies to get a deal; economics (choice and competition)—the sales pitch—was early casualty**
- **Contradictory promises were overlooked**
- **Utilities were greedy, traders smarter**
- **Causes/solutions appallingly misreported, reinforcing dumb agendas in CA and DC**
- **Actual causes are complex and interactive**

A simple question

- **How could a California electricity system that met a 53-GW peak load in summer 1999 fail to meet a 29-GW peak load in January 2001?**
 - Yes, there was a hydro drought (–5 GW), some plants were down, etc...
 - But half the capacity didn't disappear!
- **Something beyond a simple capacity inadequacy must have occurred. Hmmm...enough capacity, not enough electricity, so...?**

California electricity mess: noncauses

- **“Soaring electricity demand”**
 - Actual 1990–99 kWh sales growth av'd only 1.15%/y – half the growth rate of GSP (Si Valley was 1.31%/y)
 - '99–'00 CA h'ly pk load –4.6%, av daily pk load +4.8%, kWh +4.6%(p), but 2000 was hot, leap y, w/GDP +8.7%
 - In short, nothing very unusual happened to demand
 - Cf. 1–6/01: kWh/kW_p –10/12% weather-normalized, –12/14% weather- & GDP-normalized—undid 5–10 y!
- **“Huge electricity demand growth from Internet”**
 - Strong coal-lobby disinformation campaign claims Net is now using 8–13%, soon →50%, of all U.S. el.
 - Now permeates media, snookered opinion leaders
 - Decisively rebutted (<http://enduse.lbl.gov/Projects/InfoTech.html>)
 - Actually, all data/telecom equipment uses 2% of U.S. el.; adding all office equipment, telco switches, and all their manufacturing energy still yields only 3%
 - Data centers use <1.6% of Bay Area, <0.12% of U.S. el.
 - Internet probably saves indirectly more than it uses

California electricity mess: noncauses

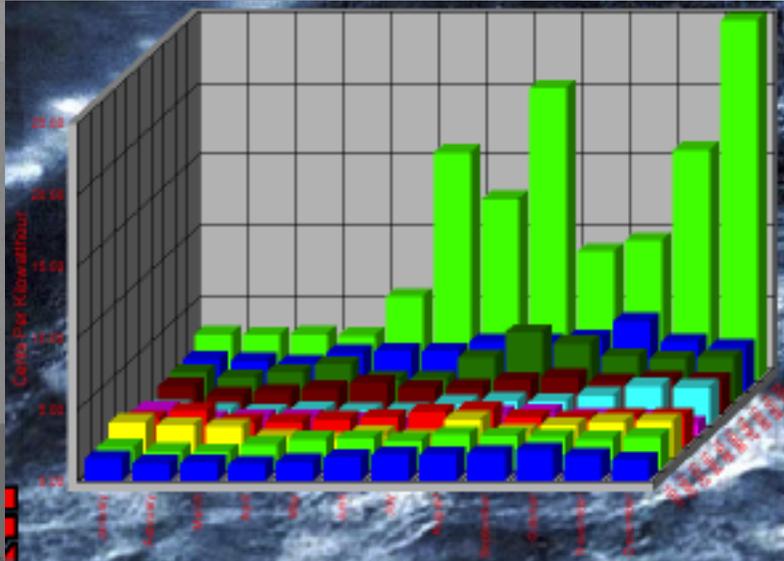
- **“California built no power plants in the 1990s”**
 - **Actually built ≥ 4.5 GW, $\sim 1/10$ of the CA pool’s peak demand, at least equal to the state’s nuclear capacity**
 - **But most was distributed and nonutility, averaging ≤ 35 MW/unit, so invisible...but kept the lights on**
 - **New version of fallacy: CA “built no major power plants,” as if units had to be big to be effective**
 - **No environmental/siting constraints prevented construction of more big plants in the ’90s (though siting is a chore); cost did, so nobody wanted to**
- **“Desperate fuel shortage” (White House, 1/01)**
 - **President says “We’re running out of energy,” tries to conflate CA el. with claimed national oil (and gas) shortages in the hope of Arctic Refuge oil drilling**
 - **Only 1% of CA’s el. (3% of U.S. el.) is made from oil; 2% of U.S. oil makes electricity; no el./oil connection**
 - **As we’ll see, CA isn’t even short of electric generating capacity, let alone of oil (though see later re gas)**

California electricity mess: proximate causes

- **Most importantly, botched restructuring**
 - **Competition to generate but no price signal to users and no bid competition by efficiency**
 - **Demand responsiveness requires access for all**
 - **Excessively concentrated market power**
 - **1/2 of bidding space prefilled by must-runs/-takes**
 - **7 firms control 2/3 of remainder; each moves market**
 - **Owners profited by selling less el. at higher price**
 - **~ 10 – 15 GW (of ISO ~ 48 GW) “calling in sick” from late summer 2000; some legitimate, but forced outage rate at least ~ 2 – $3\times$ more than when utility-owned; looks like rational profit maximization**
 - **Adequate CA and WSCC capacity throughout power emergencies, but much of it systematically offline**
 - **Bidding system rewarded gaming—no collusion necessary—a ticket-scalper’s paradise**

A decade of CA el. price history

(by Robert McCullough, with apologies for the formatting)



California electricity mess: causes (cont d)

- Wholesale 12/99 (normal prices) changes to 12/00: ISO load +0.7%, monthly pk load —19%, kWh price $\times 13$, spinning reserve price $\times 120$
- Clue: Little or no price volatility in most of 2000 in the 16 other WSCC states & CA munis that didn't do CPUC-style restructuring
- Utils. bought mainly spot, got squeezed
 - ‡ CPUC allowed 20% long-term; only SCE did so
 - ‡ Bad utility credit restricted supplies even more
 - ‡ Utility nonpayment bankrupted many independents, removing another 10+% of supply
- Anticompetitive practices cut some supplies
 - ‡ Wind w/o tx, tough interconnections, ISO illegally requiring cogenerators to sell all or no electricity,
- ~1/3 of CA's capacity and generation is renewable but its constant-price attribute was lost

California electricity mess: causes (cont'd)

– Public-policy malpractice

- **Gov. Wilson's CPUC delegated portfolio management to customers, free to buy financial hedges if they wished: the genius of the marketplace would reveal all in the daily spot market (it soon did)**
- **ISO staff not up to the task in quantity or quality**
- **ISO doesn't control QF or (directly) other dispatch**
- **ISO claimed to dispatch ~50% of nameplate capacity; "securing scarcity in the midst of abundance"**
 - **Notionally moving CA units to OR would increase their output ~30–50% (McCullough analysis)**
- **ISO is not actually "independent" as name implies**
- **ISO & SCE insolvent, PG&E & PX bankrupt, State...?**
- **Data secrecy (on both bids and outcomes) destroyed transparency, aiding strategic bidding but not permitting open analysis of concentration of market power, operation of individual plants,...**
- **"Disaster designed by a committee"**

– FERC's radical abdication of its 1935 core duty

California electricity mess: deeper causes

- **Mid-1990s loss of momentum in DSM**
 - **World-class programs had saved 10 GW (1/5 of CA pool's peak demand) by early 1990s**
 - **Restructuring derailed DSM; utilities slashed 1995+ budgets by >40%; ≥1.1 GW of peak savings foregone, equiv. to ≥1.3 GW supply**
 - **SCE '91 forecast 259 MW/y 1995–2000; CEC proj'd SCE/PG&E ea. ~100–150 but got 40–70**
 - **Legislature revived DSM in 9/00, but didn't allow SPA to buy eff. on same terms as kWh**
- **Utility DSM disincentivized and penalized**
 - **Successful policy to reward cutting bills, not selling more kWh, reversed in 1996 from 1/98; Legislature started to fix only 11 April 2001**

California electricity mess: deeper causes

- **FERC in '95 canceled 1.4 GW of well-bid clean capacity urged by environmentalists—utilities said no need for the power**
 - **SCE claimed this a month before canceling DSM programs underlying its forecast**
 - **Conveniently reduced competition**
 - **AB1890 paid \$90M for power never bought**
- **CA generators chose not to build major new units, though they could have**
 - **Prices low, siting difficult, enthusiasm low**
 - **CEC dutifully licensed through '90s; >6 GW since 4/99, >7 GW more poised to follow**
- **Winter 2000 NW hydro –1/2, losing 5 GW**
- **Some tx bottlenecks limited transfers**

California electricity mess: deeper causes

- **Tightening regional power-pool reserves**
 - **The other 16 states/provinces sharing same cap. did little/no DSM, had pop/ec'c. boom**
 - **CA, ~40% of WSCC, was ~15% of peak rise '95–99**
 - **Other 10 W states averaged over 2× CA's +kWh; typical Las Vegas house* 2–3× kWh/y of Bay Area**
 - * In 1985, Nevada Power's summer peak load was 45% res'l a/c. RMI showed the NV PSC how simple changes could cut a typical new house's kW_p by 91%, kWh/y by 93%, energy bills by >90%, and utility investment by \$20k at no extra construction cost. Today's opportunities are not much smaller. CA could thus strengthen, even buy, DSM in high-growth, low-DSM WSCC states like NV, AZ, NM, and CO, more cheaply than expanding supply.
 - **CA, biggest net importer, got the most volatility (mainly because NV/AZ/NM freeloaded on reserve)**
- **NO_x trading cost > cleanup; mkt. gamed?**
- **Coordinated maintenance scheduling and system operations lost by dis-integration**
 - **Utility contracts to maintain expired fall '00**
 - **New mgrs had no incentive against outages, which soared ~3–10× when they took over**

California electricity mess: deeper causes

- **Huge winter natural-gas price spike***
 - 30 Nov 2000 S CA gas storage down 89% from '98 and '99 due to stupid restructuring of gas market arrangements—then cold snap and pipeline explosion (deliverability –5%)
 - Claimed pipeline cap. manip'n being litigated
 - Gas-fired generators pass through their spot gas prices — even if they've hedged!
 - As S CA gas hit \$25+/MBtu, firms said they couldn't generate beneath ISO and FERC price caps, so were allowed to blow past 'em
 - Theorists assumed physical and financial transactions were equivalent; they're not

*William Marcus & Jan Hamrin, "How We Got Into the California Energy Crisis," 2000

California electricity mess: deeper causes

- Natural gas price spikes >\$50/MBtu at times in S CA 1/01 did contribute to the electric price spikes—~30% of CA's el. is gas-fired—but much more than that was evidently happening
 - Wholesale 2–3¢/kWh → av. 15+¢ in summer 2000
 - That average price redoubled in 12/00–1/01 despite demand far below summer peak; \$1.50/kWh 13 Dec
 - Some power producers also produce/distribute gas
- **Legislature put most of the green power marketers out of business by linking utility bailouts to 10-y exclusive relationships**
 - Largely eliminated the actors who, against odds, did the most to bring choice to customers and constant-price resources to market
 - CPUC completing the job (no retail choice)?

In short...

- ***The marketplace performed brilliantly***
- ***Actors followed the incentives given them***
- ***Nobody looked after the public interest***
- ***Cascading policy failures made it far worse***
- ***The political motivations of most parties continue to distort choices and decisions***
- ***Least-cost investment was abandoned***
- ***Customer choice and competition have arguably decreased and are shrinking***
- ***Theorists forgot el. is very hard to stock-pile, short-term inelastic, and essential***
- ***\$7¹/₄b '99, \$33¹/₂b '00, \$7¹/₂b 1st 6 wks '01: biggest interstate wealth xfr. in U.S. history***

But volatility goes both ways...

(N Y Times, 8 June 2001; AP, 11 June 2001)

- ***CA electricity prices suddenly fell again***
 - ***Spot >\$400/MWh late May, <\$50 early June***
 - ***August contracts down from \$700 to ~\$200***
- ***Many complex interactive causes***
 - ***5.2 GW back from maintenance outages (?)***
 - ***2.2 GW added by 6/00, 3.8 more by autumn***
 - ***~5 GW of indeps. got debts settled, back up***
 - ***BPA freed 1.2 GW, expected 1.2 more in June***
 - ***5/00–5/01 weather-normalized av. peak-hour load –4.5 GW (!); then +30–50% prices 6/00...***
 - ***State signed ≥\$43b long-term power contracts***
 - ***Gas (~\$60/MBTU 12/00) \$11.7 end May, El Paso merchant contract ended, ~\$3.5–7 by 11 June***
 - ***Cooler weather, hotter politics***

Apparent stabilization starting?

- ***Electricity savings accelerated in June***
- ***In the first half of 2001, Californians reversed ~5–10 years' demand growth—~10× faster than the supply-side response***
- ***Cool July has CA selling surplus at a loss!***
- ***Should continue, esp. w/new surcharges***
- ***Supply also improving steadily***
- ***Helpful shifts at FERC; Pat Wood,...***
- ***Hot weather and equipment failures remain an ever-present possibility***
- ***But now the focus is shifting to long-term financial stabilization***

Where do we go from here?

- ***Many nonsolutions and solutions are being pursued vigorously; some will work***
- ***Some are working surprisingly well; too many?***
- ***Creating more stranded assets***
- ***May well already be in overshoot***
- ***Strong revival of DSM & renewables, but still badly underinvested compared with supply***
- ***The lawyers will get rich fighting over the rents***
- ***Key Q: will CA debt remain investment-grade?***
- ***Politics are complex, volatile, and national***
- ***Producers are running scared (rightly)***
- ***Watershed for public/decentralized power?***

So starting from where we are...

- ***Now that outside-purchased-power debt is being socialized, pay it off much sooner?***
 - *Split DSM savings between rapid debt payoff and customer bill reductions, rewarding both*
- ***Act quickly to diffuse excess market power***
 - *If the same firms that have too much market power now build any significant fraction of the new capacity, they will simply have more capacity to withhold, and no less reason to do so*
 - *They're rich, so can outcompete small firms*
 - *More MW, if not very diversified in ownership and preferably in scale, may worsen shortage*
- ***Full & fair competition—both supply & DSM***
 - *Make owners run their capacity, not hoard it*
 - *Let DSM compete comprehensively vs. supply*

More next steps

- ***Dilute, diffuse, or break up excess market power—many ways, none easy***
 - *Some new & creative: short the pwr mkt?*
- ***Shift psychology to a buyer's market (already well underway) via fast demand cuts and distributed gen.***
 - *DSM & rens. added >15 GW to CA by 2000, + another >5 GW just in 1-2Q2001*
 - *Buy savings from other Western states?*
 - *Encourage demand-responsiveness*
- ***Beware overshoot: CA has 12–33 GW, WSCC 102, US 200, planned by 2007!***
- ***Fix gas storage and market quickly***
- ***Community initiatives, better design***

Some basic questions

- **Short-run social value for el. is $\geq 10^2 \times$ its long-run production cost**
 - El. costs $\sim 1\%$ of GDP, but blackout stops most prod'n.
 - Threat of blackout raises market price to 10–100 \times cost
 - High capacity/price elasticity \rightarrow profitable withholding
 - Market price limited only by FERC, or customer assets
 - Contracts then convert short- into long-term rents, little of which get reinvested in CA electricity supply
- **So if we base price on value, not cost, are we prepared for $\geq 10^2 \times$ price jumps?**
- **Don't the resulting losses dwarf claimed inefficiencies of a well-regulated monopoly?**
 - Regulated, even state-owned el. looks relatively efficient!

Big underlying issues remain

- **Why must competition be retail too?**
 - Wholesale competition, which was already in place, captures nearly all the same benefits without most of the risks
- **Do we believe in a least-cost portfolio of resources, or will we continue to slight the demand side and invest in supply?**
 - Even EPRI, which should know better, presents DSM only as an emergency response, not as a major portfolio element or a systematic competitor against supply
- **Will we continue to bail out bad buys?**
- **Why do we tolerate such poor reportage?**

The sobering saga of California's 1980s shortage-to-glut transition

- ***In 1984, CA had a ~37-GW peak load***
- ***Had committed 12 and was buying another 7 GW of demand-side resources through '94 (~10 were ultimately procured, ~9 lost)***
- ***By 3/85, had 20.3 GW of independent generation, mostly renewable, on firm offer, 57% of it online or contracted and being built—plus another 9 GW per year!***
- ***By 4/17/85, when the CPUC suspended most new small-power contracts, 13.1 GW was already under contract and another 8+ GW was in negotiation***

California's shortage-to-glut saga (2)

- ***Thus, had this boom continued through 1985, those dispersed generators, averaging only 12 MW and with lead times ranging from months to a few years, could have displaced all 27 GW of thermal plants in California***
- ***The transition from scarcity to glut took only two years—yet well after it ended, at least 24 other states and provinces were still seeking to sell CA their surpluses simultaneously***
- ***CA and US now seek to reproduce this experiment; the same results can be expected as fast DSM (& dxd. gen.) outrun slow supply***
- ***A very bad movie—we needn't see it again***

National lessons

- *Markets produce surprises, but don't serve the public without rules*
- *Efficiency remains the biggest opportunity—and threat to oversuppliers*
- *Boom-bust is costly and unnecessary*
- *Demand is not fate but choice*
- *Demand is extremely flexible and fast*
- *Distributed generation is roaring in*
- *Technical innovation is accelerating*
- *Surprises can come from any direction. For example:*

5×-more-efficient midsize SUV



An illustrative, uncompromised, manufacturable, and costed concept car (Nov. 2000) developed for a few million dollars in 8 months by Hypercar, Inc. (www.hypercar.com), on time and on budget, with attributes never before combined in one vehicle

- *5 big adults, up to 69 ft³ of cargo*
- *Hauls 1,013 lb up a 44% grade*
- *1,889-lb curb (47% Lexus RX300)*
- *Head-on wall crash @ 35 mph doesn't damage passenger cell*
- *Head-on collision with a car twice its mass, each @ 30 mph, meets U.S. occupant protection standards for fixed-barrier crash @ 30 mph*
- *0–60 mph in 8.2 seconds*
- *99 mpg-equivalent (5 times RX300)*
- *330 mi on 7.5 lb of safe 5-kpsi H₂*
- *55 mph on just normal a/c energy*
- *Zero-emission (hot water)*
- *Sporty, all-wheel digital traction*
- *Ultrareliable; flexible, wireless diagnostics/upgrades/tuneups*
- *200k-mile warranty—no dent/rust*
- *Competitive cost, big mfg. advantages*
- *Can ultimately save an OPEC...and displace coal & nuclear 5–10 times!*

About the author: A consultant experimental physicist educated at Harvard and Oxford, Mr. Lovins has received an Oxford MA by Special Resolution (by virtue of being a don), seven honorary doctorates, a MacArthur Fellowship, the Heinz, Lindbergh, World Technology, and Heroes for the Planet Awards, the Happold Medal of the UK Construction Industry Council, and the Nissan, Mitchell, Shingo, "Alternative Nobel," and Onassis Prizes; held visiting academic chairs; briefed 14 heads of state; published 27 books and several hundred papers; and consulted for scores of industries and governments worldwide, including the oil industry since 1973. *The Wall Street Journal's* Centennial Issue named him among 39 people in the world most likely to change the course of business in the 1990s, and *Car* magazine, the 22nd most powerful person in the global automotive industry. His work focuses on whole-system engineering; on transforming the car, energy, chemical, semiconductor, real-estate, and other sectors toward advanced resource productivity, and on integrating resource efficiency into the emerging "natural capitalism."

About Rocky Mountain Institute: This independent, nonpartisan, market-oriented, technophilic, entrepreneurial nonprofit group was cofounded in 1982 by its co-CEOs, Hunter and Amory Lovins. RMI fosters the efficient and restorative use of natural and human capital to help create a secure, prosperous, and life-sustaining world. The Institute's ~50 staff develop and apply innovative solutions in business practice, energy, transportation, climate, water, agriculture, community economic development, security, and environmentally responsive real-estate development. RMI's \$5-million annual budget comes roughly half each from programmatic enterprise earnings (mainly private-sector consultancy) and from foundation grants and donations. Its work is most recently summarized in *Natural Capitalism* (with Paul Hawken, www.natcap.org, 9/99).

Further information is available at www.rmi.org.