ENERGY SECURITY: THEN AND NOW

Policy Shifts Across Five Decades

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INTRODUCTION

California's distinct pattern of energy policy after the 1973 Arab oil boycott has served the state well and, decades later, holds insights for addressing present-day energy challenges. Key features where the state moved differently from more prevalent national policies of the time include:

1. Gaining control of energy forecasting through publicly managed and transparent data collection and analysis.
2. Tying needs identified in forecasting to procurement for those needs, including clear directions for utilities and other public electricity providers for what technologies fit best and cost least.
3. Developing industrial policies that help key new energy assets to scale and reduce their costs over time.
4. Setting clear longer-term directions for meeting energy needs, setting timelines, and building policy and leadership tools for accountability, coordination and problem solving.
5. Anticipating needs for upgrades in ancillary infrastructure like transmission lines needed for large-scale renewable energy generation (and recently for increasing electrification of sectors like buildings and transportation.)

Learnings from California's playbook can help us with forward-looking solutions to major energy challenges we face today.

- Early efforts for energy efficiency reduced residential, commercial, and industrial demand for electricity. Expenditures to make those improvements have been costly, but as consumers use less electricity, California utility residential electric bills are close to the national average.
- State policies call for increasing improvement in air quality and reductions in carbon emissions. Just as co-gen and efficient gas turbines outcompeted coal and oil as a cheaper source for electricity, even cleaner energy technologies like renewables are now cheaper than natural gas power plants. Fuel switching to clean electric technologies can further reduce residential consumer energy

costs significantly as households switch from gasoline for their cars and natural gas for appliances.

- New technologies are reshaping key industries: data centers and AI have a voracious appetite for electricity, and are predicted to transform large manufacturing, service, and logistics companies. EVs are already growing in personal transportation and offer life cycle savings in heavy-duty transport. But existing public planning tools are not adequate to predict need and infrastructure upgrades. Nor is energy efficiency a prominent part of the discussion and proposed action in these sectors.
- These transitions will reshape energy use and energy policy in large parts of the California economy. State agencies and decision-making bodies will also need to change, as the pace of innovation demands clear, coordinated, and faster action.

MARK TWAIN WARNED US THAT IF HISTORY DOESN'T REPEAT ITSELF, IT DOES OFTEN RHYME.

In 1973, Arab oil producers embargoed shipments to the U.S. in response to U.S. support for Israel during the Yom Kippur War. The sudden and sharp impacts were a rude awakening for federal policymakers and Americans whose rising oil consumption had garnered little concern in the lead-up to the embargo, despite the nation's growing reliance on foreign imports.

"Before 1973, energy policy could be summed up this way: America ran on oil, and the oil industry ran on favorable tax treatments. Fuel was cheap, cars were large, and it may shock folks to know that virtually all electric power generation that was not coal, hydro, or nuclear was oil-fired. How much oil? In the 1970s, Southern California Edison was the second largest U.S. consumer of oil, surpassed only by the Pentagon."[1]

Consumers faced gasoline shortages and long lines at the pumps, alternating days for lining up at gas stations based on odd or even numbers on license plates, and skyrocketing fuel costs for heating oil as well as gasoline. National leaders called for emergency measures under the banner of "energy security" or "energy independence," pressing for speedy measures to "build it, dam it, drill it."

President Nixon announced a "Project Independence" focused on converting oil-powered electric plants to coal and completing an Alaska Oil Pipeline that was intended to free America from its dependence on imported oil. Congress, meanwhile, created the Federal Energy Administration (FEA), charged with allocating scarce fuel supplies and imposing price controls.

[1] Dan Richard first came to California during this period to serve as an advisor to former astronaut Rusty Schweikert after newly elected Governor Jerry Brown appointed Schweikert as an early California Energy Commissioner. Richard observes here and elsewhere in a series of posts in the *"Friday Burrito"*, a weekly energy trader journal. See https://docs.google.com/document/d/15JQTmJym7pFcdfOgUNR120yug4WC34Gx/edit?usp=sharing&ouid=113746306975187976158&rtpof=true&sd=true

(photo from Marty Lederhandler, KPBS, The 1973 Arab Oil Embargo: The Old Rules No Longer Apply, 10/16/2013)

Taking a different approach, California's leadership doggedly pursued a multi-pronged effort over the following decades to address the challenge from several angles:

- Taking away sole control of energy forecasting and energy planning from utilities and oil companies and vesting a more transparent process in California's public energy agencies;
- Squeezing efficiency out of the state's existing energy uses before building expensive power generation deemed by private and often self-interested companies as necessary to meet new demand; and
- Beginning to plan and order procurement from gas and electric utilities that jump-started new cost-effective and less volatile technologies.

These strategies were met with skepticism on the national stage, with some commentators snarkily predicting that "Californians would starve to death in the dark." Contrary to the harsh rhetoric about high electric bills and unreliable power, the state has been relatively successful in making a transition away from the panicky mainstream reactions of 1973 toward a different, but still successful, design for energy security.

California's progress offers important lessons that can be applied to the pressing energy challenges facing the state and nation today.

STRIKING OUT IN A DIFFERENT DIRECTION

Even before the Arab Oil Boycott, the California Legislature in 1972 had adopted a bill to develop energy efficiency standards for ducting and insulation in new building construction. In addition, a legislative committee in 1972 had commissioned the RAND Corporation[2] for a report to inform ongoing hearings on energy policy in the state. The RAND research stretched over several years and focused on forecasting future energy demands in California, developing policies for power plant siting and setting regulatory responsibilities, and identifying the impact and competitive opportunity that consumer electricity conservation measures could provide.

As Dan Richard writes, "In those days, economic growth was assumed to be tied directly to energy consumption, which was growing 7%/year, thus doubling each decade. Rand reported that if that trend continued, California would need a major nuclear or coal plant every 20 miles along the entire coast." Other reports at the time also identified utility plans for as many as 15 new coal plants in the California Central Valley, raising opposition in agricultural communities like Chico and Bakersfield over competition for precious local water resources.

Findings from the RAND research planted the seeds for an alternative approach that could yield major impacts on the state's energy needs through a portfolio of actions. In summary, the RAND report noted, "In the two decades from 1975 to 1995, only a very modest addition to nuclear capacity would be needed, and in the year 2000, nuclear generation capacity is reduced… Measured in terms of the number of 1000-MW plants, only 10 nuclear power plants are required instead of 48… The combination of a number of actions, each small in itself, can be very powerful in affecting the mix of energy sources required in the future. In this example, we have combined decreases in electricity use through conservation and the substitution of solar energy with increases in electricity from geothermal and organic sources to reduce the need for nuclear power by a factor of 5."[3]

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[2] RAND, an acronym for "research and no development, is a think tank founded on military grants and based in Santa Monica, CA

[3] Running against the grain, principal researchers for the Rand report came from team members in the nuclear science programs at the University of California's Lawrence Berkeley Lab, also a source of future California policy leaders like Bob Weisenmiller and Art Rosenfeld . The citation is from page 33, Executive Summary, *Energy Alternatives for California: Paths to the Future, Rand Corporation, prepared for Presentation to the California State Assembly Committee on Resources Land Use and Energy*, September 25, 1975. The underlined emphasis is taken from the Report verbatim. The language of the Rand Report

Even as their research was underway, conversations that mirrored findings of the RAND report provided a foundation for California's energy policy, influencing the creation of the Energy Resources Conservation and Development Commission, colloquially known as the California Energy Commission (CEC), and its regulatory framework. Authors of the Warren-Alquist Act often held divergent views. Senator Al Alquist weighed toward a need to increase supply by speeding siting of large and expensive new power plants, while Assemblymember Charles Warren emphasized the need to avoid costs of potentially excessive construction and protect both ratepayers and the environment by more precise forecasting and demand reduction.

The Warren-Alquist Act attempted to address both of these goals. While then-Governor Ronald Reagan initially resisted, he eventually signed the Warren-Alquist bill in 1974. The Act, which became effective in 1975 under newly elected Governor Jerry Brown, empowered the CEC to preempt local zoning decisions on major power plants. At the same time, the new statute required that no plant could be built unless deemed "needed" in accordance with independent energy forecasts done by the CEC, circumventing self-interested parties such as power plant owning utilities and fuel suppliers. It also mandated first-in-the-nation building and appliance efficiency standards, and set up various state-run renewable energy R&D programs.[4]

Among those leading the development of a new approach to meeting the state's energy needs was Lenny Ross, a 30-year-old UC law professor and early Jerry Brown appointee to the CPUC. Assigned to the 1973 PG&E General Rate Application, Ross notably commented in the findings section that "We regard conservation as the most important task facing utilities today," continuing on to rebut the utility's plans for new power plants, stating "unchecked proliferation could not be allowed to continue," and calling for more adoption of energy efficiency and alternative energy sources.

Following on this admonition, the CPUC opened an Order Instituting Investigation (OII 26) asking PG&E to demonstrate how it planned to carry out procurement of these alternatives to nuclear and coal plants. Soon after, the CPUC acted on additional recommendations contained in Ross' Order Instituting Rulemaking (OIR 2), making energy efficiency a priority for all regulated energy utilities.

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is similar to the decades later comments of Dan Richard: 48 new nuclear power plants up the coast every 20 miles is roughly the length of the California coastline.)

[4] The newly-formed CEC attracted a class of brilliant young lawyers, economists and policy-makers (including Diane Fellman, who wrote the first rules for siting and permitting new power plants). Note that 2025 is the 50th anniversary of the CEC, and of UC Berkeley's Energy Resources Group, a critical research and learning focus that has helped propel many important thinkers, analysts and policy decisionmakers between these origin events and the current California energy cohort.

In the course of OIR 2, the concept of "avoided cost" was raised as a regulatory tool, requiring utilities to consider in their planning investments the avoided high lifetime cost of a new nuclear or coal plant, thus opening the door for cleaner resources with a lower life-cycle cost to compete. In 1979, when PG&E returned to the CPUC reporting that they had not made progress on procuring energy efficiency, the CPUC heavily fined PG&E and ordered the company to look again. The fine, while not large in today's terms, was a surprising action, capturing not only PG&E's attention, but also notice from investors and much of the energy policy world. The signal was, yes, the State of California was serious about energy efficiency, as was seizing decision-making power from the utilities regarding procurement planning.

As part of the proceedings for OIR 2 and OII 26, the Environmental Defense Fund (EDF), fronted in California by attorneys Tom Graff and David Roe. Supported by EDF analyst Zach Willey, later bolstered their testimony with results from Electric Finance (ELFIN). ELFIN was the first open-source energy needs calculator built on transparent data sets, putting all the assumptions on the table. ELFIN reinforced the findings of the Rand Report and also brought precision into the findings of the CPUC's decisions.[5] ELFIN opened up energy and utility ratemaking to a larger audience by putting numbers and assumptions out for public examination and debate, making government and public interests effective actors in shaping energy decisions, rather than the subject of purely private interest choices.

Spurred by the tumultuous energy landscape of the 1970s, California's nascent energy policies quickly gained momentum and nationwide interest. In April of 1980, then President of the CPUC John Bryson (both a founder of the environmental group NRDC and a future CEO of Southern California Edison) convened a major symposium at Stanford University. Speakers included Amory Lovins, Tom Hayden, Lenny Ross, and Daniel Yergin, the UC's Art Rosenfeld[6] as well as utility leaders, federal energy officials, environmental advocates, state officials, and major investors. The list of 150-plus attendees reads like a roster of many of California's energy leaders of the ensuing 50 years, and also showcases the progress in other states and at the national level.

[5] The EDF calculator, ELFIN, was later licensed in 1983 by MRW, a partnership of Bob Weisenmiller, Dan Richard and Susan Morse, the first major consulting firm focusing on these new policies of public energy forecasting and planning. ELFIN, later updated and coded as computer software by the Lawrence Berkeley Lab, was used as the basis for analysis and testimony in rate cases and procurement plans for years after.

[6] See more on Rosenfeld on page 10. While later documents (such as the 2007 *California Integrated Energy Policy Report,* whose Figure1 is often called the Rosenfeld Curve) have popularized the concept, many experts agree that Rosenfeld's seminal insights first appeared in his work from the mid-1970s (roughly around 1975–1977).

FROM POLICY TO PROGRESS

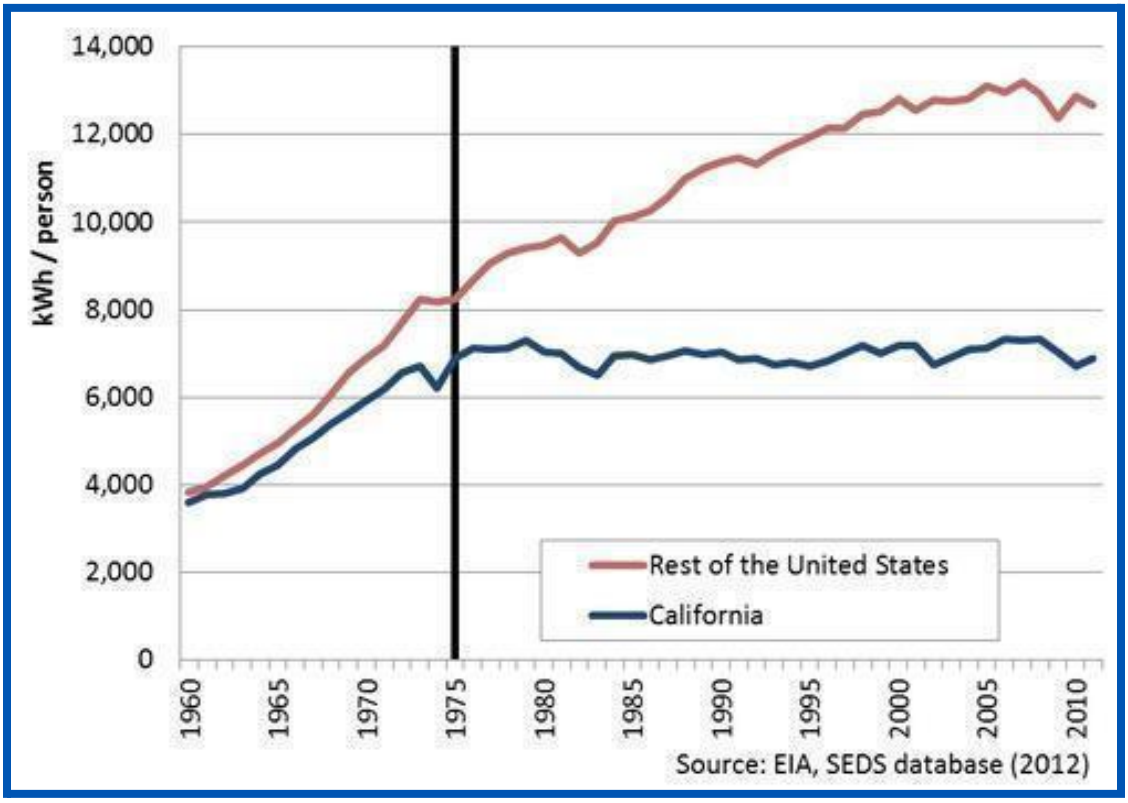
ENERGY EFFICIENCY

The CEC's 1978 Building Code energy efficiency standard—formally known as Title 24, Part 6 of the California Building Standards Code—was a landmark regulation aimed at reducing energy consumption in buildings. The first energy efficiency standard for buildings in the U.S. included:

- Mandatory Efficiency Measures: Required insulation, efficient windows, and HVAC system improvements to reduce energy waste in new construction.
- Performance-Based Standards: Allowed builders flexibility in meeting efficiency goals rather than prescribing specific technologies.
- Periodic Updates: Established a framework for regular revisions to keep pace with technological advancements.

The CEC followed up with energy efficiency standards for major energy-using appliances like refrigerators and air conditioners. Art Rosenfeld, after his appointment to the CEC, summarized many of his arguments visually through a chart (generally now called the Rosenfeld Curve) in a 2007 CEC energy forecast. The chart (see below) shows that over the 40 years after first putting energy efficiency to use as a priority energy policy, per capita electric energy use in California remained flat, while power demand across the U.S. had more than doubled over the same period.

THE ROSENFELD CURVE



Co–generation (also called co-gen, Combined Heat and Power or CHP)

Following the 1978 Congressional adoption of the Federal Public Utility Regulatory Policies Act (for more on PURPA, see the following section below), the CEC convened a conference in September of 1980 on cogeneration[7], a process for using waste heat from manufacturing and heavy industry to produce steam-powered electricity. In concert with this event, Governor Brown pushed forward new goals, calling for 6 GW of power from statewide cogeneration, and 400 MW of cogeneration from waste heat at State of California facilities.

As a tool to meet that 400 MW goal at state facilities, the Department of General Services[8] energy lead, Michael Garland, pioneered a number of key tactics, including

[7] While a form of generation, this tactic is often a more efficient use of fuels, and still showed up in many cases as a cost reduction, either from fuel savings or from sales of excess electricity to the grid.
[8]The Department of General Services (DGS) is the State of California's property owner and facilities manager, as well as fuel procurer for those operations. Because of the combined scale of state facilities, DGS provided early market weight and helped boost cogeneration and other new technologies that met facility needs more effectively or efficiently.

public-private partnerships (PPPs) with private companies that helped finance and install energy efficiency improvements and modern appliances in return for a share of saved energy costs. This pioneering effort essentially shared the risk of underperformance with providers and allowed state agencies to move costs of energy efficiency and cogeneration from their capital budget to their operating budget. The lower costs of power were then reflected in lower state budget expenditures, allowing agencies to shift savings to increased services for Californians.[9]

EXPANDED OPTIONS FOR CLEANER SOURCES OF GENERATION UNDER PROVISIONS OF THE 1978 FEDERAL PUBLIC UTILITY REGULATORY POLICIES STATUTE

While California was departing from many national policies and practices, some national innovations were also critical during this period. The Federal Public Utility Regulatory Policies Act (PURPA) was also a response to the energy crisis of the 1970s under President Carter. Bob Foster[10] said, "People ask me, 'Well, you know, governmental policy really never gets implemented, does it?' I said, 'I'll show you a policy that changed the world, and it's PURPA.' They did it at the Federal level - that started independent generation."

Primary goals of the statute included promoting energy efficiency, encouraging competition in electricity generation, and reducing dependence on fossil fuels by fostering the development of small-scale renewable energy and cogeneration facilities. PURPA required utilities to purchase power from QFs[11] at a set rate assumed to be at or below the cost of a new gas, diesel, coal, or nuclear power plant. Projects came forward

[9] Cogen is an area that continues to pay off and holds promise for further development. According to the CEC's current website page on co-gen, by 2019 California is still holding strong and "accounts for 10 percent of the United States' installed combined heat and power capacity, with 8,500 MW of operational CHP systems. According to the Department of Energy, large industrial and institutional CHP installations account for most of this capacity, because of favorable economics and mature product availability. In a recent CEC report, the technical potential for CHP in California was estimated at 8,000 MW for new applications between 50 kilowatts (kW) and 5 MW. Additionally, emerging micro-CHP technologies could open the market to thousands of commercial applications and millions of residential applications under 50 kW in size. It is necessary to develop a better understanding of small and micro-scale CHP products and examine their potential to enter the California market."

[10] Foster was the architect of the first California energy efficiency statute in 1972, serving as staff to a state legislator. He was later an early head of the CEC's energy efficiency programs, a senior executive at SCE, Mayor of the City of Long Beach and President of the CAISO.

[11] "qualifying facilities" such as smaller co-gen, hydro, geothermal, biomass, wind, or solar power plants

that could meet this "avoided cost rate" test, and California saw the rapid emergence of a class of non-utility "independent power providers" of generation. While PURPA was instrumental in diversifying both diversity power provider technologies and California's energy mix, implementation also faced challenges, including disputes over avoided cost calculations and evolving regulatory frameworks.

When the CPUC later sought to determine a regulatory process for evaluating "avoided costs", Dan Richard relates, it produced two standard offer contracts that utilities would offer to test market prices for independent power producers, but "energy price fluctuations made financing projects under the standard offers impractical." While it took years to produce an enduring means of setting avoided costs, by 1990, the CPUC was finally ready to proceed with an auction for new resources as part of a "Biennial Resource Plan Update (BRPU). "The results stunned the utilities. Although everyone believed the utility IDR[12] was low-balled, the bids from non-utility generators came far below those numbers. This was likely the result of a quiet revolution that saw dramatic improvements in the efficiency of gas turbines through the 1980s."

Prodded by Dian Greuneich, at the time an attorney for the CEC, and aided by energy economics consultant Bill Marcus, the CPUC began in 1987 to explore "decoupling" mechanisms to separate utility revenues from electricity sales, ensuring that utilities are incentivized to support energy efficiency and clean energy procurement through contracting out, rather than continuing to build, own and operate their own power plants. The historic pattern of allowing utilities to own their own power plants (described as vertical operations) drove utilities to seek more costly options that they owned over seeking the best-priced power for ratepayers.

A significant milestone in California's decoupling efforts came with the CPUC's Decision 97-05-040, issued on May 6, 1997. This decision was part of broader electric industry restructuring efforts, ensuring that utilities could recover fixed costs of power while promoting efficiency and renewable energy. Governor Gray Davis later appointed Greuneich as a Commissioner at the CPUC.

DEREGULATION

The eventual success of these efforts - PURPA's mandate to procure QFs, the success of the BRPU competitive bidding process set forward at the CPUC (see explanation above

[12] IDR was the avoided cost price for energy contracts negotiat,,d in a 1990 CPUC proceeding.

on page 13), and decoupling - came at a time in the Reagan Administration when telecommunications and the airlines had been deregulated nationally, leading to more competition in those industries, lower prices, and new services. This, in turn, led to a focus on the electric industry and eventually, to discussions on restructuring the role of the CPUC as well as deregulation of power utilities.

The head of the CPUC's Strategic Planning Division at this time, Gigi Coe, led a team that examined how deregulation in the phone and airline industry had fared, as well as the experience of the British deregulation of their electric and coal industry. This regulatory examination was published in a report called the "Yellow Book," and later Coe's team issued a "Blue Book" of detailed exploration of options for California's reform of the utilities and the CPUC.

The regulatory studies and recommendations were supplanted by a hurried legislative process in 1995, with SB 1890 signed into law by Governor Pete Wilson in 1996. SB 1890 created competitive wholesale and retail electricity markets, and the new market structure began to emerge in 1998 as the legacy utilities began to sell off their generation to independent power providers and energy traders.

The legislative market design failed catastrophically in 2000 during a statewide heat event, leading to an ongoing energy crisis with rolling blackouts and massive spikes in wholesale energy prices and market manipulation by wholesale traders. The immediate crisis was eventually resolved by the State of California signing contracts for power, achieved at great cost to California consumers and significant strains on regulated utilities, which, under California law, had to serve their customers, but were prevented from passing on the full costs of power that those utilities were mandated to buy from a manipulated market. PG&E, running out of credit, eventually declared bankruptcy. The Legislature later reversed many provisions of SB 1890.

Still, an enduring result that significantly shapes California energy policy today was a mandate for regulated utilities to sell their generation (except for legacy hydroelectric plants and nuclear power stations). The failed deregulated market was replaced by a new "bilateral" market whereby the CEC issues an energy needs assessment every two years, the CPUC orders regulated utilities to issue a request for bids, and the incumbent electric utilities evaluate the bids based on "least cost/best fit" criteria, and sign contracts that meet requirements. An Independent Evaluator and a Procurement Review Group of nonmarket advisors provide additional oversight on proposed contracts before the CPUC approves them.

The California Independent Systems Operator (CAISO), created as part of deregulation, keeps the grid in balance,[13] accepting bids for the least cost resources to generate electricity daily, weekly, and monthly as power needs change on account of weather conditions and predictions of electricity demand.

For the regulated utilities, this basic formula persists: they don't make their money from selling electricity. They get paid a fixed cost for the service of procuring contracts, and then separately earn a percentage on their costs for the construction and operations of transmission lines and other hard infrastructure.

RENEWABLE PORTFOLIO STANDARD AND (AB 32) - THE GLOBAL WARMING SOLUTIONS ACT OF 2006

Coming out of the 2000 energy crisis following the collapse of flawed electricity deregulation in California, the Legislature approved a Renewables Portfolio Standard (RPS) in 2002, in part to spur development of new generation and to reduce the ability of a few natural gas plants to manipulate the wholesale markets. The RPS mandates that California's utilities procure increasing amounts of electricity from renewable sources, expecting that those contracts would induce competition to build large-scale independent renewable power plants in California, and as new technologies scale, their costs would drop.

AB 32, also known as the Global Warming Solutions Act of 2006, was a landmark climate policy adopted by the Legislature and signed by Governor Schwarzenegger. The measure required California to reduce greenhouse gas emissions to 1990 levels by 2020. AB 32 was the first law in the U.S. to set legally binding emissions reduction targets. The RPS was strengthened to align with AB 32's climate goals.

As well as a tool for procuring clean power, the RPS also functions as an industrial policy which seeks to scale, by preferences and mandates, new technologies to transform the electric industry. As the RPS became a success, it grew in scope:

- 20% by 2010 (original target)

[13] Before deregulation, individual utilities managed reliability within their own grids. During the debate over deregulation, independent generators argued that the utilities often used this role to keep non-utility providers from being able to connect to the grid. The CAISO was created as a neutral "air traffic controller" to ensure fair access to the grid, as well as managing reliability.

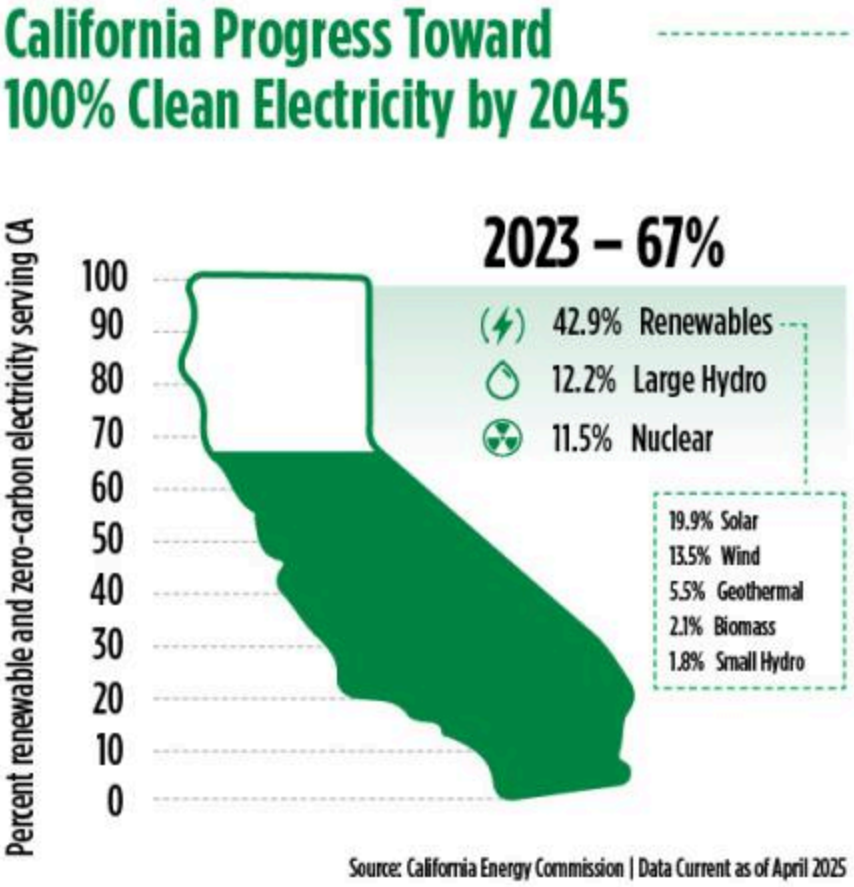
- 33% by 2020 (expanded under Governor Schwarzenegger)
- 50% by 2030 (under SB 350 in 2015)
- 60% by 2030 and 100% carbon-free by 2045 (under SB 100 in 2018)

AB 32 and the RPS have dramatically reshaped California's energy landscape: California phased out coal-fired power plants, replacing them with renewables. Because wind and solar don't depend on fuels that must be purchased in volatile national - and now global - markets, renewable power plants offer price certainty for decades.

According to the Energy Commission website, in **2023, 42.9 percent of California's retail electricity sales were served by RPS-certified renewables. Together with large hydroelectric and nuclear power, 67 percent of California's retail electricity sales come from zero-carbon, clean generation.**[14] And, as the supply chain for renewables has matured, prices for these technologies have dropped.

Investments mandated in statutes and regulations for energy storage and transmission upgrades have helped integrate intermittent renewables. All in all, the fast decline in the cost of renewables has put the same economic pressures on new development of coal and natural gas power plants throughout the Western U.S. as California's turn toward energy efficiency and co-gen did to fuel oil power plants.

[14] https://www.energy.ca.gov/data-reports/clean-energy-serving-california



POLICY AND ORGANIZATION TO SUPPORT THE TRANSITION TO RENEWABLES

The Italian advisor to local nobility, Niccolò Machiavelli, observed in his guidebook to governing, *The Prince*: "It ought to be remembered that there is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things." One of the important steps in California's transition was a recognition of the importance of setting clear direction, providing coordination, and creating accountability for policy implementation.

While the Legislature was approving the RPS, California energy agencies worked together to create the Energy Action Plan, which created a roadmap to develop more electricity resources in California. Part of the Energy Action Plan was The California Energy Loading

Order. The Loading Order dictates which resources the agencies and the IOUs should prioritize. Specifically, the Loading Order calls for priorities in power generation and dispatch through California's grid:

1. Energy efficiency and demand response — reducing consumption through efficiency measures and shifting demand to off-peak hours.
2. Renewable energy generation.
3. Clean distributed generation, including combined heat and power (CHP) systems.
4. Conventional generation: fossil fuel-based power plants as a last resort.

Ultimately, the Legislature codified energy efficiency as the priority in the Loading Order, solidifying regulatory decisions as statute. To coordinate efforts on these new challenges, a group of key policymakers and agency leaders known as the Energy Principals formed and became instrumental in cohesive progress and success. The initial lineup was:

- Michael Peevey (President of the CPUC)
- William Keese (Chair of the CEC)
- Mary Nichols (Secretary of the California Environmental Protection Agency)[15]
- Robert Foster (President of the California Independent System Operator)

Even as agency leadership changed, the Energy Principals continued to work together as a high-level interagency body that vigorously supported implementation of AB 32 and coordination of siting, permitting, and interconnecting large renewable energy projects during the American Recovery and Reinvestment Act period from 2008 through 2014.

[15] While the Energy Principals were an effective leadership body as a whole, it's also important to acknowledge the special role of Mary Nichols, who as the head of CalEPA and former leader of the California Air Resources Board used many of the air quality regulations as a stick to prod cleaner energy rules, and also applied the carrot of cap and trade to support clean electricity projects and utility efforts to support energy efficiency.

THE AMERICAN RECOVERY AND REINVESTMENT ACT OF 2009 ARRA) (AND THE RENEWABLE ENERGY ACTION TEAM (REAT)

The American Recovery and Reinvestment Act (ARRA), promoted by President Obama and adopted by Congress in 2009, also played a crucial role in accelerating California's Renewable Portfolio Standard (RPS) efforts by providing financial incentives that leveled the playing field with previously existing hefty subsidies for fossil fuels.

- Federal Tax Credits: ARRA allocated a 30% federal tax credit for eligible renewable energy projects, making large-scale solar and wind developments more financially viable.
- Fast-Track Permitting: The law encouraged expedited environmental reviews to accelerate project approvals.
- Transmission Investments: ARRA funding supported grid upgrades to integrate new renewable power plants.

California had already carried out a planning effort through a collaborative exercise called the Renewable Energy Transmission Initiative (RETI). The participants, including environmental and clean energy advocates, labor groups, utilities, and other stakeholders, mapped out the most likely sites for various renewable energy projects and designated likely transmission routes to markets. This, in turn, helped renewable energy developers locate the least conflict sites for their projects.

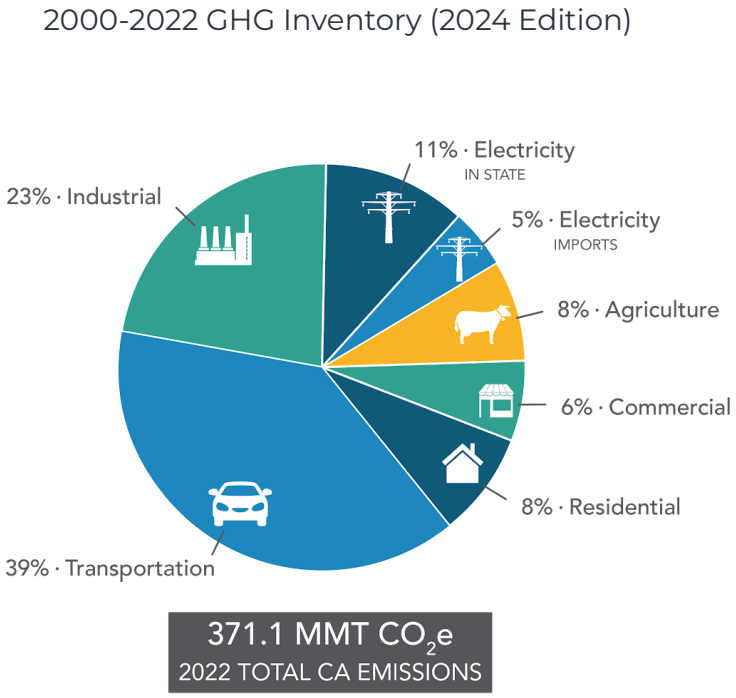
In October 2009, Governor Arnold Schwarzenegger and U.S. Secretary of the Interior Ken Salazar signed a Memorandum of Understanding (MOU) to expedite renewable energy development in California. The agreement established a joint state and federal Renewable Energy Policy Group and a smaller leadership group, the Renewable Energy Action Team (REAT), that coordinated and kept the process accountable to the ambitious ARRA timeline. Driven by four high-level staff in the Governor and Secretary's office, meeting with developers and agency staff on a daily, weekly, and monthly basis, the REAT provided close coordination and troubleshooting for permitting and siting activities. These efforts resulted in a stunning 20,000 MW of new wind, solar, and geothermal power plants in California that qualified for ARRA funding by commencing construction before the end of December 2011.

WHAT NEXT?

While California was held out to national ridicule in the 1970s for pursuing strategies to reduce demand and force new technologies into the electric sector, its progress has seen the state's energy policies modeled in jurisdictions across the nation and the globe. Learnings from California's playbook can help inform forward-looking solutions to the major energy challenges we face today. These include:

ELECTRIFY EVERYTHING

The RPS can only do so much. Currently, only about 16% of California's carbon emissions come from the electric industry; some 39% comes from transportation of people and goods, and another 20% comes from buildings. California can reach a goal of 100% carbon-free electricity, but still fails to reach its economy-wide greenhouse gas emissions goals.



Graphic: California's greenhouse gas emissions in 2022 broken out by economic sector[16]

[16] https://ww2.arb.ca.gov/ghg-inventory-data

The California Energy Loading Order has evolved significantly over the past two decades, adapting to new technologies, policy shifts, and the urgency of climate change. The Loading Order now emphasizes electrification as a primary strategy, particularly in those emission-rich transportation and building sectors.

This will require increasingly switching to clean electricity as a fuel in place of natural gas used in air conditioning and heating, and gasoline and diesel used as vehicle fuels. In the future, energy efficiency will still be recognized as the least cost/best alternative for clean energy and clean air. But *energy efficiency can no longer be simply defined as using less electricity.* When electric generation was dirty, one of the most accessible ways to reduce pollution was to reduce electricity consumption. As electric generation moves closer and closer to being carbon-free, decarbonizing the overlying energy sector will depend on using more clean electricity.

- The CEC's newest building codes require "net zero housing," with solar on the roof or from utilities, highly efficient heat pump water heaters, and more energy-saving building construction standards.
- A natural gas-powered heater uses a source of energy that causes/ has pollution. A high-efficiency heat pump will be "plugged into" an electric grid that is cleaner and increasingly carbon-free.
- A gasoline or diesel-powered car uses a source of energy that is polluting and causes pollution. An electric car is "plugged into" an electric grid that is clean/carbon-free. Hydrogen fuel cell cars are also not polluting, and the hydrogen can be generated with solar, wind, or other clean electricity.

It is not clear that existing policymaking, clear goals, and coordinating programs adequately support a new clean energy transition that seeks convergence between the currently separate gas, electric, and petroleum industries. Leadership at the highest agency level has yet to create the right kinds of rules for success for this new path. "Electrifying everything" is a task akin to the transformation of telecommunications, where phone service, cable, and the internet were once separate industries - but where nowadays, the same companies from those formerly very different industries now provide the same overlapping and bundled service through cell phones, fiber to homes and businesses, and access to the internet.

For this new transition to be durable and to scale affordably and reliably, we'll need both a willingness to develop, coordinate, and implement the programs needed to get there and more leadership to make those programs accountable to a clearer long-term direction.

Current policies remain very aspirational and need work to become effective. Examples include:

- Renewable energy developers seeking to meet procurement targets set by the CEC and the CPUC point to the need for faster development of transmission to meet those timelines. They also seek better coordination between state goals and local land use planning. Existing programs and direction to the staff implementing these programs need to change to overcome conflicts with other existing policies and to fully map out the transition.

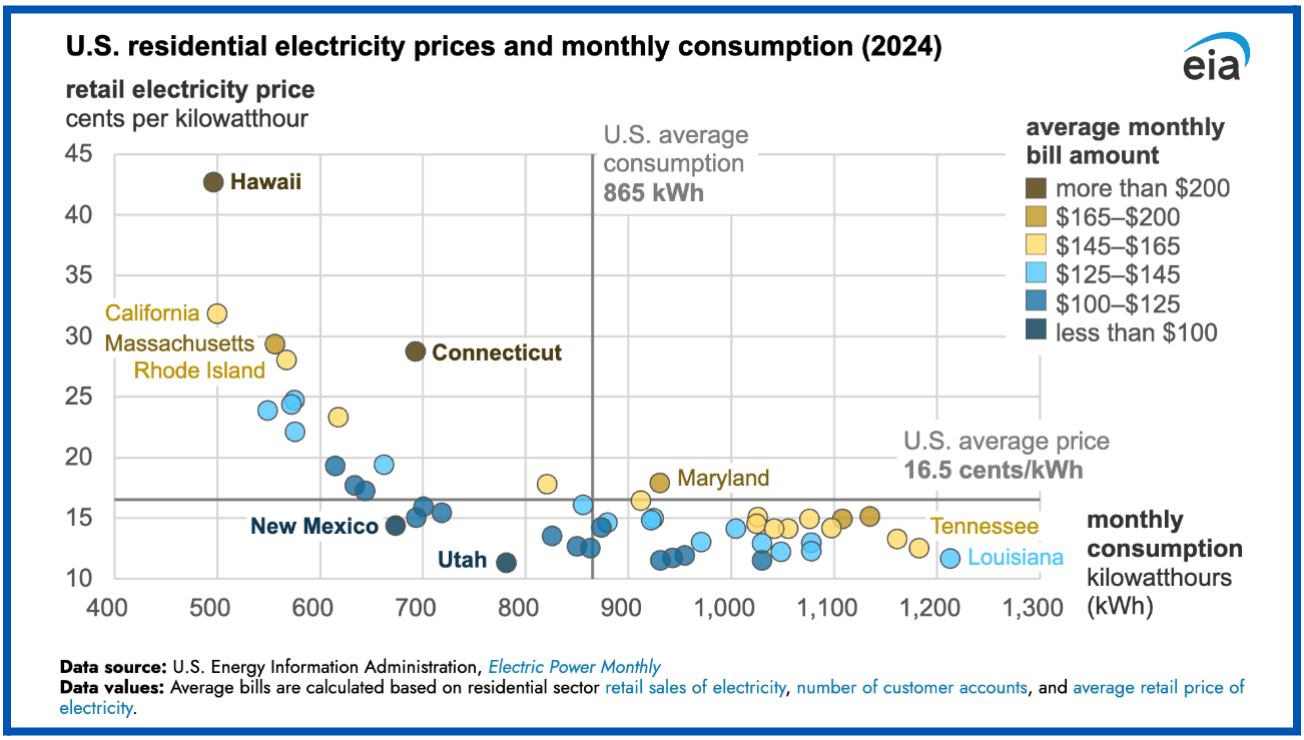
- Heavy vehicle operators need substation improvements to handle the timelines set by the CARB. Utilities need better insight as to where land use and transportation planners see the growth, and permission from the CPUC to make these expensive upgrades

- New technologies like rooftop solar, natural gas, and hydrogen fuel cells, software programs that allow variable consumer use, like smart thermostats that track variable rates in homes. Operations in the low-voltage grid are harder to predict and manage. The fast-paced adoption of these tools offers benefits and risks. But the vision and architecture of two-way distribution systems are still unclear and lack clear leadership and governance. The electrification transition will require upgrading the low-voltage distribution systems: more smart devices like meters and neighborhood transformers, more communications with central operators, newer low-voltage transmission, more capacity on residential and commercial breaker panels, etc.

AFFORDABILITY

Rates that set the price of electricity in California's electricity rates are high in comparison to those in many other states. But, because of California's policy of energy efficiency as a top energy resource, consumers use less power, resulting in lower bills than in many other states. Simply put, although California's electric rates are higher than other rates around the nation, the energy efficiency measures that have been deployed mean the typical California consumer's electric bill is still close to the national average - $160 in California versus $142 nationally.[17]

[17] https://www.eia.gov/electricity/sales_revenue_price/pdf/table_5A.pdf



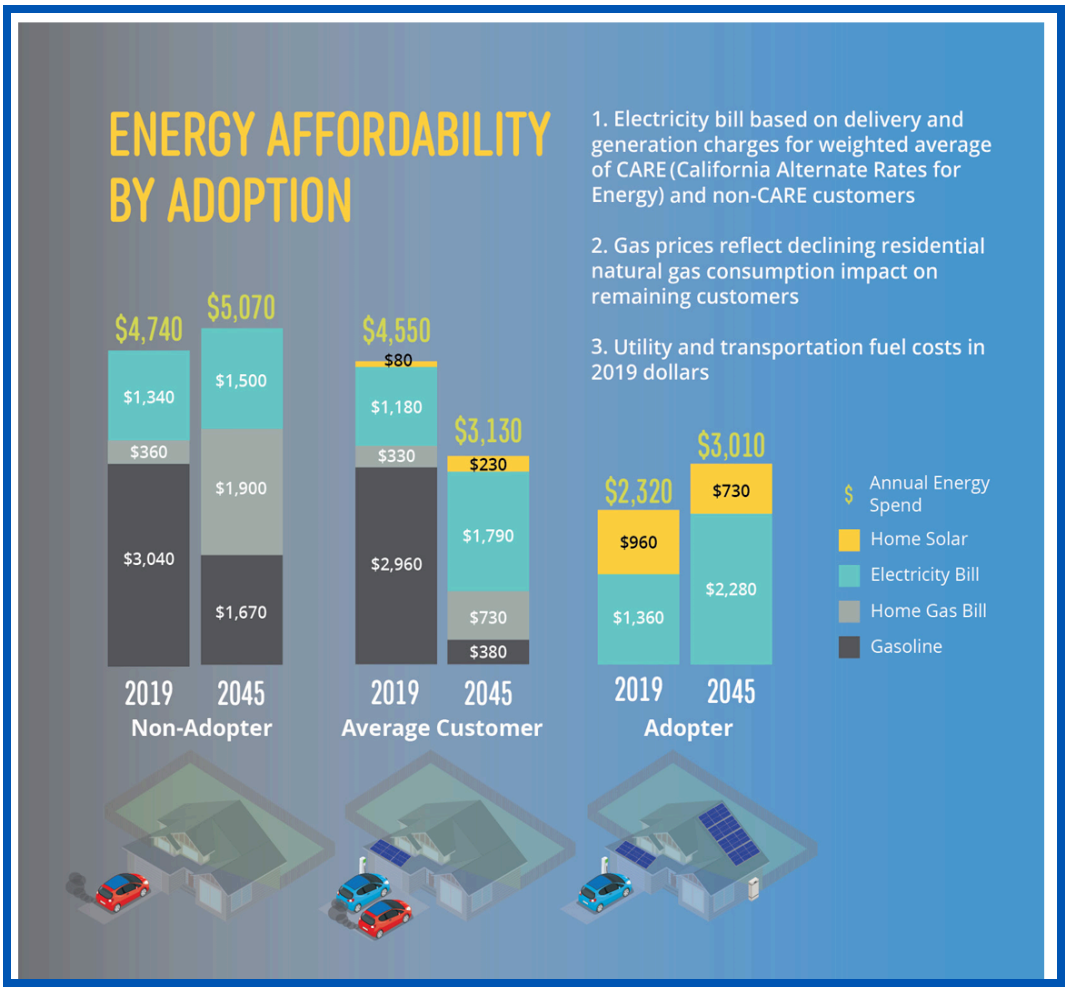
How do these higher rates and lower bills fit with California's efforts to electrify everything? Southern California Edison's Pathway 2045 report[18] outlines the steps California must take to achieve carbon neutrality by 2045:

- 100% Carbon-Free Electricity: All retail electricity sales must come from carbon-free sources.
- Electrification of Transportation: 26 million EVs and 1 million+ electrified medium/heavy-duty vehicles will be needed.
- Building Electrification: 70% of buildings must use efficient electric space and water heating.
- Energy Storage Expansion: 30 GW of utility-scale storage will be required to balance intermittent renewables.
- Grid Modernization: The grid must be hardened and expanded to accommodate increased electrification.

[18] *Pathway 2045 | Edison International*

- Policy Alignment: Regulatory frameworks must evolve to support electrification and clean energy expansion.

As a result of this transition, electric demand will increase by 60%. But overall, the report finds consumers will save: "The good news is that, when assuming reasonable cost and efficiency improvements over time, a decarbonized, electrified world produces energy savings for an average household due in part to significant energy efficiency gains. While electricity bills increase over time, the energy consumption cost for an average household decreases by one-third by 2045[19]. Household savings are driven by reduced gasoline consumption due to the high market penetration of electric vehicles."



[19] Emphasis added.

MANY FEAR THAT GROWTH IN DEMAND WILL STRAIN THE GRID AND HINDER ECONOMIC GROWTH

"All regions of the North American electric grid are expected to have sufficient resources under normal operating and weather conditions this summer, but some may face supply shortfall risks during periods of extreme heat," the North American Electric Reliability Corp (NERC) said recently in its annual 2025 Summer Reliability Assessment.

Peak demand across NERC's 23 assessment areas is forecast to increase by 10 GW since summer 2024, "more than double the increase from 2023 to 2024," NERC said in a news release. Data centers, electrification, and industrial growth are driving demand higher."[20]

"The electrification of heating systems and the adoption of electric vehicles are expected to drive New England's annual electricity consumption to rise 11% over the next decade, according to the region's grid operator. The ISO is forecasting steady growth in net annual energy use as state policy goals for carbon emissions reductions drive the increased electrification of heating systems and transportation in the region," the New England regional grid operator said in a May 2025 blog post about its 2025–2034 Forecast Report of Capacity, Energy, Loads, and Transmission. Other regional grid operators report electric demand to increase by 9% per year for the next decade as states in their jurisdictions build energy-hungry data centers to support the emerging AI industry.

California utilities are joining the chorus: In 2025, PG&E, which delivers power and natural gas to about 16 million people in northern and central California, including Silicon Valley, announced a process for data center developers interested in connecting to the utility's system. The so-called cluster study yielded 4.1 gigawatts of interest, on top of the 8.7 gigawatts announced during the company's most recent earnings call in late April, said Mike Medeiros, PG&E's vice president of South Bay Delivery. Not only did the pipeline of prospective data centers being built within PG&E grow, but the size of the projects has also jumped since the previous year's cluster study. Last year, the typical data center wanting to power up through PG&E had 50 to 100 megawatts in capacity. Current proposals are for projects of 500 megawatts to as much as 1,000 megawatts."[21]

[20] Summer demand is soaring and inverter-based resources are a 'key risk': NERC | Utility Dive)
[21] "Biggest California utility sees more than 40% jump in data center interest, executive says," Lailey Kearney, *Reuters*, May 22, 2025

Calling to mind the discourse surrounding the 1973 energy crisis, current national policy discussions focus primarily on removing barriers to financing and constructing new power plants. The Republican policy journal, Reason, printed an article in its June edition with a banner headline: "The U.S. Needs More Nuclear Power To Fuel the AI Boom," and outlines plans in Texas, Virginia, and Pennsylvania for using nuclear power to meet data centers' energy demands.

The author, Jeff Luse, states: "The Department of Energy also expects data centers' energy use to balloon. A December 2024 report forecasts that cloud computing will account for as much as 12 percent of the nation's annual energy use by 2028—up from 4.4 percent in 2023. Virginia, California, and Texas will each serve as a "primary hub" for both small- and large-scale cloud data centers, according to the Energy Department."

Texas is the fastest-growing consumer of electricity in the nation, according to the Energy Information Administration. In 2024, the Electric Reliability Council of Texas (ERCOT)—which manages about 90 percent of the state's grid—said electricity demands could nearly double by 2030 as data centers and cryptocurrency grow and as oil operations in the Permian Basin begin to run on electricity instead of diesel. In March, ERCOT said it has received requests for 99 gigawatts (GW) of new connections—enough to power almost 25 million homes—from large power users (including data centers) in the past year. The state will need to add the energy equivalent of 30 nuclear power plants by 2030 to meet demand, reports Bloomberg."

APPROACHES TO MEETING RISING DEMAND

Despite the appetite in some corners to meet the increasing demand through new power plants, this approach faces several challenges. "The White House wants to deploy 300 GW of net new capacity by 2050, and have 10 large reactors under construction in the U.S. by 2030 while expanding domestic nuclear fuel supplies, according to an executive order President Trump signed."[22]

Even optimistic predictions for the new small modular nuclear reactors don't expect them to be available until the mid-2030s. And efforts to start up currently mothballed older large nuclear plants will take years. New large-scale reactors aren't likely: the recently opened Vogtle reactors in Georgia were 15 years late and cost $17 billion over the

[22] The date of the Executive Order was May 23, 2025, as reported in "Trump aims for 300 GW of nuclear by 2050, 10 large reactors under construction by 2030," *Utility Dive,* May 28, 2025.

proposed budget. Referring to the recent Presidential Executive Orders, "Nuclear power advocates hailed the orders as a boon for the industry, but warned that staff cuts at NRC and DOE could slow progress. A representative for the Union of Concerned Scientists said the proposed reforms would make the public less safe."[23]

Natural gas plants intended to produce power for AI data centers (and other drivers of growth in electric demand) face their own challenges – the cost of new gas-fired generation is rising, just as the cost of renewables and batteries is dropping. Infrastructure consultant Wood McKenzie is among many energy analysts who point to major obstacles to new natural gas power projects. They cite a lack of turbine manufacturing capacity, with escalating costs partially due to on-again, off-again tariffs and uncertainty as to whether the data center demand actually materializes.[24]

While U.S. policy seeks to lead in AI development and to speed data centers to support this new technology, it's not clear that we will overcome the many obstacles to building power plants that meet assumptions. There are some steps we can take to reduce the projected power need and to avoid overbuilding expensive generation.

- In response to overly speculative transmission interconnection requests, grid operators are increasingly seeking evidence of power project viability – executed contracts, for example – that shows that there is a real project – a way to make expectations more real for data centers, as well.

- Google has publicly discussed its efforts to find more efficient ways to cool massive chip arrays needed for data centers. A stronger effort toward energy efficiency that meets the cooling needs can drastically reduce the high projections for energy needs – and likely produce results faster.

For EVs, a partial answer may be energy efficiency, as well. Current EVs are energy hogs – while cheaper than gasoline, they are still in need of more efficient design and batteries. This will be especially important for major concentrations of heavy-duty EVs. While current EV drayage vehicles can't offer much, time-of-use rates for charging that ramp up over time can smooth demand peaks, and potentially serve as one of many incentives for expedited research by vehicle and battery manufacturers.

[23] Ibid.
[24] The new landscape for gas-fired power: turbocharged or turbo lag? | Wood Mackenzie)

FINAL NOTES

California can still gain benefits from the same policy tools deployed in 1973:

- Keep a steady hand on energy forecasting, and avoid the urge to surrender wholesale that important tool to self-interested parties, whether they are oil companies, utilities, large customers, or anticipated large future loads like data centers or AI.
- Set clear goals for meeting demand and manage procurement so this transition also takes into account newer technologies that are cleaner, more efficient, and reliable, and that reduce price volatility. Some nimbleness and flexibility is needed in rules and regulations because clean energy technologies move at such a rapid pace.
- Keep government processes efficient and accountable through identifying key leaders with real authority, with tangible deliverables, and through clear and open coordination between agencies with different missions and authorities.

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