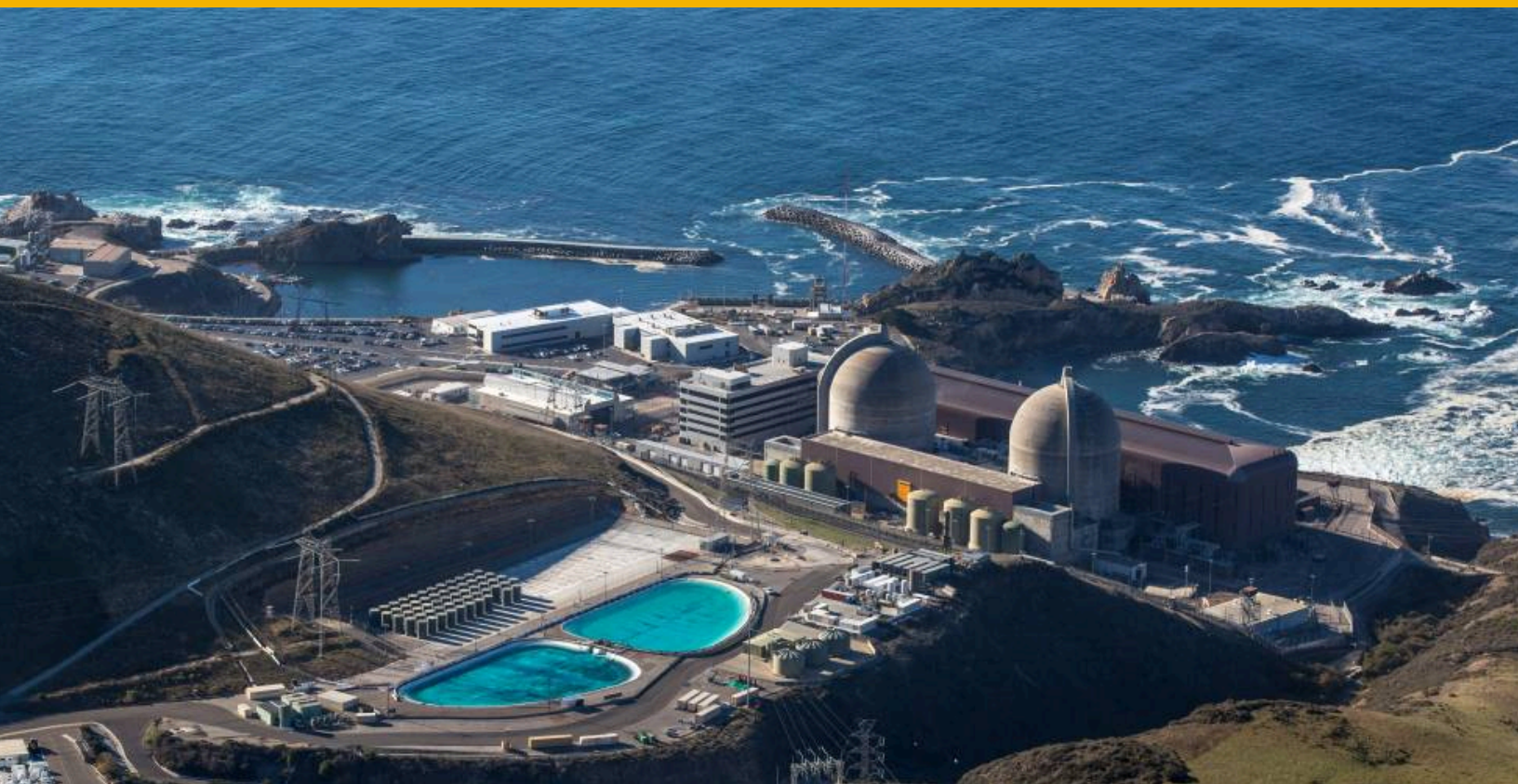
GOLDEN TOGETHER

Energy Abundance

Reliable, affordable energy that's good for people and our environment

Prepared by Golden Together, A Movement to Restore the California Dream



Foreword

California's energy policy is a broken, incoherent and destructive mess. A reckless and headlong pursuit of wildly unrealistic "climate" goals has the state's political leadership pursuing a policy of "green" energy at any cost. But the cost is too high and the results aren't even green.

Despite subjecting Californians to what by now must be trillions of dollars in economic costs, California relied on fossil fuel for 80 percent of its energy in 2022, compared to 81 percent in the United States, and 82 percent worldwide. That's not much of a return on investment.

Even by their own standards, California's "green" policies are not yielding "green" results. Notwithstanding the vast and disproportionate cost in resources to develop "renewable" energy, and the destructive impact on the environment of giant industrialized solar and wind farms, California's CO2 emissions dropped just 7 percent in the past decade, from 348 million metric tons (MMT) in 2013 to 326 MMT in 2022. Again, not much of a return on investment.

(If politicians and bureaucrats simply allowed responsible logging again in California's forests, as laid out in our previous policy report, 'Reducing California's Carbon Emissions through Modern Forest Management', they could eliminate CO2 emissions from wildfires by as much as 100 MMT per year. But CO2 emissions from wildfires are conveniently not counted in the official statistics.)

Meanwhile, prices for electricity and gasoline in California are the highest in the nation, driving businesses out of state and putting financial strain on working families. The impact of high energy prices disproportionately harms small businesses and low income households. This has been combined with a maniacal zeal to electrify everything, even as our electricity grid strains to meet current demands - let alone our needs in some fantasy "decarbonized" world where all cars, trucks, trains and domestic appliances are electric.

This is not even to mention the building resentment among Californians of all backgrounds at a staggeringly authoritarian nanny state government arrogantly telling them what car to drive, what truck to use and how to cook their food.

It is all insane, and none of it is necessary.

It is time for California's politicians and bureaucrats to admit that the official, stated goal of achieving "net zero" (no net emissions of greenhouse gas by 2045) is not only impossible and incredibly expensive, but a pointless exercise based on the obviously false assumption that other states and nations will follow suit.

In this report, we propose an energy strategy for California that makes sense, delivering reliable, affordable energy that is good for people and our environment.

Our plan will replace unrealistic goals with practical policies to ensure abundant energy that will power our economy and guarantee families energy security. Realistic environmental goals will be met, rather than fantasy targets being missed.

In recognition that electricity may never be a preferable or even feasible solution for many energy uses, we believe the regulatory war on California's oil industry must end. Before the current era of "climate" extremism, California produced around 80% of the oil we use. Today we use only a little less, but nearly 80% of it is imported - on giant supertankers, the most polluting forms of transportation on the planet, spewing out carbon emissions as they ship oil from places with terrible human rights records, like Iraq or Venezuela, instead of using the oil we have here - the most cleanly produced in the world.

Rather than import oil, we call for California's in-state production to increase, while imports are reduced proportionately. If and when alternatives to oil become commercially competitive, attractive to consumers, and affordable without commercial subsidy, the market may determine a reduced dependence on it. Until then, we can and should produce it locally with much lower environmental impact than if we continue to import it.

This is true not just of imported crude oil but refined gasoline too. The government war on the oil and gas industry is forcing California refineries to shut down. If this continues, we will need to start importing finished gasoline, driving up gas prices (already the highest in the nation thanks to California's taxes and regulations), as well as increasing carbon emissions - another example of the utter incoherence of current policy.

Ending the irrational and counter-productive "war on fossil fuels" must also include expanding, rather than restricting, the use of lower-emission natural gas generating plants. Simply allowing our current plants to operate in the way they were designed - a reliable and lower-carbon source of 'baseload' power - would dramatically expand reliable energy supply, bring down costs, and protect the environment from the ravages of solar and wind industrialization. It would also incentivize investments to upgrade or replace gas-fired plants to use the most advanced combined cycle designs, which would further lower electricity costs to the consumer.

We also recommend a major expansion of reliable carbon-free power by retaining and expanding California's nuclear power capacity. This can be fulfilled by keeping Diablo Canyon open while permitting new large and small scale reactors, including new designs that capture heat for community use.

The current, irrational obsession with unreliable, intermittent solar and wind power must end. The planned despoiling of California's coast and coastal waters by giant industrialized wind turbines the height of the Eiffel Tower near Morro Bay and Humboldt must not be allowed to proceed. Policy on solar power should be directed towards rooftop solar ("energy independence" at the household level) rather than polluting more and more of our landscapes with giant industrialized solar 'farms'. The true costs of solar must be honestly assessed, with utility scale providers including the cost of battery storage in their pricing.

Our plan offers a positive and practical alternative to California's current, disastrous energy strategy. The policies we recommend create a level, unsubsidized playing field where all forms of energy production are incentivized to compete to provide abundant, low cost energy. Along with eliminating all state subsidies for energy producers, we recommend scrapping laws that mandate specific technologies both in the production and consumption of energy. While reasonable air quality standards should remain in place, we recommend eliminating the net zero targets the state has set, returning our focus to minimizing pollution and waste that is indisputably toxic.

Affordable, reliable energy is a basic expectation of the government.

Yet by now most Californians have seen the ads, either on prime time television, online, or even on billboards, exhorting us to "Power Down 4 to 9PM." These ads are produced by "Energy Upgrade California," paid for by "investor-owned energy utility customers under the auspices of the California Public Utilities Commission and the California Energy Commission." This "Power Down" campaign is perhaps the most vivid example of California's deliberate policy of ideology-driven energy rationing and energy scarcity.

Normal people need more electricity between 4 and 9 PM, and no amount of "public education" can overcome that circadian fact. This is the time of day when many people finish their daily work, prepare and eat dinner with their families, complete routine and necessary chores from doing the laundry to packing lunches for the next day. This is the time of day when people want to heat or cool their homes to a comfortable temperature, and power up all the countless electronic gadgets which are now required for everything from homework to paying the bills. They don't want to wait till 9 PM to do any of this. By 9 PM they want to relax. Or go to bed!

There is no reason whatsoever that a state as wealthy and innovative as California, with its much touted "5th biggest economy on earth," needs to exhort its citizens to "Power Down" at precisely the time of day when they want to power up. We can and should have Energy Abundance in California. Energy is something we should not have to worry about.

Our plan recognizes and provides the flexibility for new energy solutions to emerge that we cannot currently imagine. In this way, we leave open the opportunity for California's powerful tradition and capacity for innovation to be fully applied to the worldwide challenge of providing clean and reliable energy at a competitive price. If there is anywhere on earth where investors and inventors can develop and commercialize large scale sources of clean energy, it's right here. Our plan would deliver clean, affordable and abundant energy to Californians today, while also encouraging and enabling the next generation breakthroughs we're all waiting for.

Steve Hilton
California, January 2025

Keypoints

- Abundant, affordable and reliable energy is feasible and sustainable.

- California has an opportunity to set an example with its energy policies that other states and nations will enthusiastically follow, but current policies have the opposite impact.

- By attempting to achieve “net zero” CO2 emissions, we forfeit our chances to innovate, and impose unacceptable costs on all Californians.

- The California Air Resources Board’s (CARB) 2022 “Scoping Plan Update” calls for a capacity of 500,000 gigawatt-hours (GWH) of clean electricity per year by 2045. This is nearly double the current in-state generating capacity, and cannot possibly be achieved in a cost-effective manner without reliance on natural gas, large scale hydroelectric, and nuclear power.

- For electricity generation, California should classify as “clean energy” nuclear and highly efficient (70 percent or more) natural gas power.

- California relies on petroleum for 50 percent of its energy, and natural gas for 30 percent of its energy. At the same time, California imports 75 percent of its petroleum and 90 percent of its natural gas. It is not feasible to abruptly eliminate these fuels.

- Instead of importing petroleum, we should increase in-state production, and maintain production until cost-effective alternatives are found. Significant sectors of our economy cannot be converted to run on electricity and will require combustible fuel for the foreseeable future.

- Sales of new automobiles should not be restricted to EVs. Less restrictive policies that allow all forms of automotive technology to compete (without subsidies) will encourage innovation to develop increasingly efficient and affordable automotive technologies.

Introduction

The economic health of every nation on earth depends on access to abundant, affordable and reliable energy, and California is no exception. But in an ideologically-driven prioritization of "decarbonization" over all other goals, including other environmental ones, policies approved and implemented by the state legislature and executive branch have led to Californians paying the highest prices for energy in the United States. This has harmed our businesses and inflicted hardship on household budgets. That hardship has disproportionately afflicted working families.

Instead of striking a realistic balance between delivering affordable energy and protecting the environment, the overriding goal that defines California's state energy policy today is "to achieve carbon neutrality by 2045 or earlier." That is, by 2045, official policy is to have our state's total annual emissions of CO2 either equal to zero, or to the extent there are any emissions, to offset them completely through projects designed to either absorb atmospheric CO2 or sequester CO2 emissions underground. At best, this is an outlandishly unrealistic undertaking. To be less charitable, these policies are a catastrophic, misanthropic blunder guaranteed to impose crippling costs on California's households and businesses while doing more harm than good to the environment.

The purpose of this report is to evaluate California's current energy strategy, and propose an alternative that offers a more realistic balance between environmental objectives and the economic and social well-being of all Californians. The core premise of our work is that energy abundance is feasible and sustainable, can be achieved primarily via private investment, and that with abundance comes affordability, reliability, and fairness - as well as a platform for California's economy to grow, flourish and lead the world. We contend that California's current energy policies offer none of those attributes, and we conclude this report with a comprehensive set of specific policy recommendations that would, if implemented, deliver to all Californians abundant energy that is affordable and reliable, while protecting our environment.

As it is, 80 percent of California's energy inputs still arrive in the form of fossil fuel - 30 percent from natural gas, and 50 percent from petroleum. And in spite of our advanced technology; despite decades of effort and cost, our dependence on fossil fuel is not significantly different from the rest of the world, which also relies on fossil fuel for around 80 percent of its energy.

Ever since the Global Warming Solutions Act was passed by California's state legislature in 2006, this goal of achieving "net zero" has imposed parameters that affect virtually every law, lawsuit, regulation, executive order, and funding priority coming out of Sacramento. The policies deriving from the mission to achieve "net zero" by what is now less than 20 years in the future affect every sector, including water, agriculture, housing, transportation, and manufacturing. But nowhere is the depth of the planned transformation more profound than with energy.

In the analysis to follow, our alternative strategy recognizes the value of increasing California's in-state electricity generation capacity. While we recommend reversing state mandates that force electrification, for example of the state's transportation sector, we support the goal of upgrading and expanding California's power grid to deliver abundant and affordable electricity to power growth and increased demand across all sectors. The burgeoning demand to power AI applications alone promises to substantially increase California's electricity consumption.

To increase capacity we propose a practical approach to electricity generation. Our analysis finds the greatest future potential for cost-effective, reliable and competitive electricity generation in three areas: advanced combined cycle natural gas power plants, nuclear power, and decentralized, unsubsidized and privately owned photovoltaic arrays deployed primarily on rooftops. We suggest deregulation to incentivize the introduction of promising new vehicle-to-grid technologies that will enable EV owners to use their cars as decentralized storage assets which in aggregate could easily replace the need for utility scale storage. At the same time, we emphatically recommend repeal of any mandates to limit new car sales after 2035 to EVs, since that eliminates the potential for automotive innovations to earn market share.

In all cases however, and in particular with respect to photovoltaic and battery storage technologies, we reject any form of public subsidies or mandates, and argue that the ultimate mix of electricity generation technologies should be determined by which solutions offer the lowest cost and best service to consumers.

In parallel, to meet the remaining demand for thermal fuels necessary for the many applications that cannot use electricity, we propose increasing California's in-state production of oil and natural gas, while reducing imports. If overall demand for oil and natural gas is to eventually decline - the so-called 'energy transition' - that should happen organically through consumer choice, rather than top-down government control.

Overall, we recommend flexibility in the state's strategic energy planning, so that whatever technologies eventually emerge as sustainable and price competitive can be allowed to flourish.

Green and sustainable energy abundance is possible, and California should be leading the way. We can do that with policies that enable a diversified, competitive energy landscape that delivers affordable, reliable energy to all Californians while creating the rewarding jobs of the future. Most importantly, the policies laid out in this report will help our economy and our environment together.

California's Current and Future Energy Needs

California boasts the fifth largest economy in the world, with a state GDP in 2023 measured at $3.9 trillion. According to the International Monetary Fund, the entire world's GDP in 2023 was estimated to be $101 trillion. This means California's GDP is nearly 4 percent of world GDP while our energy consumption is only 1.2 percent of the worldwide total. We have already become very efficient at delivering wealth with the energy that we consume.

But this statistic is misleading. Our economy is weighted disproportionately towards services that are not energy intensive. For example, in 2022 California's financial and real estate sector was 19.1 percent of GDP, professional and business services were 14.2 percent, information technology was 10.6 percent, education and healthcare services represented 7.5 percent of California's GDP, and the government sector represented 11.7 percent. Manufacturing only accounted for 11.9 percent. Meanwhile, we import manufactured products, just as we import oil, natural gas, and virtually all of our 'renewables' infrastructure including wind turbines and blades, photovoltaic solar power cells, and batteries.

So: when evaluating the composition of California's energy supply today and in the future, we should recognize that we rely on manufacturers outside of California for most of our durable goods as well as most of our energy, and therefore we directly impact the environment in every place where the energy we use is extracted or our energy equipment manufactured.

California's official, stated energy strategy relies on three dubious assumptions. First, that most energy applications, across all sectors of the economy, can be electrified. Second, that the state's electrical generating capacity can be doubled simply by the expansion of solar and wind generation while at the same time phasing out reliance on natural gas power and even eliminating nuclear and hydroelectric power. Third, that the efficiency of end-user energy consumption can be roughly doubled through electrification and other measures such as stricter building codes and adoption of mass transit. Every one of these assumptions is fatally flawed.

Electrification and Efficiency at What Cost?

There is nothing wrong in theory with striving for optimal efficiency when generating and consuming energy. Energy consumption in California, measured in TBTUs (trillion British Thermal Units), is just over 7,000 TBTUs per year. Only about one-third of that is realized in the form of energy services. The rest is lost in the transmission and conversion of raw energy inputs such as crude oil and natural gas into vehicle horsepower and home heating, or into electricity for cooling, pumping, computing, lighting, etc.

But mandating electrification and energy efficiency comes at tremendous cost to consumers, who are forced to replace their appliances and automobiles, and retrofit their homes and buildings. The consequences of these mandates also harm businesses that have to incur these costs while still needing to match prices with competitors in other states that don't have the same requirements.

Perhaps affected the worst by electrification and efficiency mandates are low income Californians who can least afford to buy or rent homes or vehicles that carry these increased costs. Let alone the social costs of the government telling people what car or truck to drive, how to heat their home, or how to cook their food.

And yet this is official state policy. Forcing consumers and businesses to embrace technologies that aren't economically competitive and are often unreliable and annoying.

The entire premise of mandating electrification and efficiency fails to take into account the simple logic of supply and demand. If efficiency innovations offer ongoing savings that outweigh the initial investment, consumers will adopt them voluntarily. A good example of this is hybrid cars, where new models are now offered at prices comparable to conventional vehicles, while offering significantly better miles per gallon. Letting efficiency innovations proliferate via consumer choice is a fair and reasonable approach that could well transform California's energy economy without mandates and subsidies that impose burdensome costs on taxpayers, households, and businesses.

The biggest target for the top-down regulators is California's transportation sector, which is barely one percent electrified, and where 47 percent of our energy supply is consumed. Not only is it the biggest consumer of energy, it is by far the most inefficient, with only 21 percent of the raw energy input (almost all petroleum fuels) being realized as automotive traction. By converting to EVs, theoretically, efficiencies of 80 percent can be achieved, which would reduce California's total energy inputs by 2,050 TBTUs. But it is a grave error to force current EV solutions onto drivers in California while excluding all other technologies.

For example, ongoing advances in internal combustion engine technologies continue to improve gas mileage in conventional vehicles. Similarly, impressive improvements continue to be delivered with hybrid vehicles. Why exclude innovative transportation options that are becoming simultaneously more affordable and sustainable? At the same time, why spend hundreds of billions of taxpayer dollars to subsidize a network of EV charging stations, if advanced hybrids are chosen on the basis of superior price and performance by willing consumers, without requiring any expensive and precipitous transformations of our refueling infrastructure? And why make EVs mandatory before we fully understand how we will cost-effectively recycle millions of tons of spent EV batteries, or come to terms with the fact that the resources necessary to build EVs are being unsustainably sourced from nations with minimal environmental standards or protections for labor?

What about California's other economic sectors? As it turns out, they already operate at relatively high efficiency. California's residential and commercial sectors both operate at an estimated 65 percent energy efficiency and represent 16 percent and 13 percent, respectively, of our total raw energy inputs. Our residential sector, which already derives 32 percent of its energy from electricity, could increase that percentage by replacing natural gas appliances with electrical appliances for space and water heating, along with cooktops and ovens. Similar conversions could also be made in our commercial sector, which already derives 48 percent of its energy from electricity.

But what would be gained by forcing such transitions? By an authoritarian government bureaucracy telling people how to heat their homes or cook their food? These sectors already make relatively efficient use of energy, and because they consume a relatively small share of our total energy use to begin with, dramatic energy savings will not be found even if we engage in massive additional efforts at electrification and efficiency upgrades. To be specific: even if we got to 80 percent efficiency in California's residential and commercial sector, by mandating electrification in the home and workplace, that would only reduce California's total energy inputs by around 350 TBTUs. Out of 7,000. Why annoy so many people for so little gain?

Reviewing these numbers can get tedious, which may explain why California's legislators apparently ignore them. They lead to an unequivocal conclusion: The amount of energy that will be saved by forcing California's residential and commercial sectors to electrify is not worth the cost. Moreover, many of the things that the politicians and bureaucrats want to force us to use will never deliver the quality or practicality of existing appliances. Electric cooktops are a perfect example.

The remaining sector, industry, represents 24 percent of California's end-use energy consumption and operates at an estimated 49 percent efficiency. But the paths towards electrifying this sector, which is still only 11 percent electrified, are not obvious, if they are even possible. Alternatives to electrification include carbon offset projects and CO2 sequestration, expensive undertakings, with their billion dollar price tags passed on to the consumer. We might also consider using hydrogen and other so-called "carbon neutral" combustible fuels. In theory, if these alternative forms of net-zero energy managed to also achieve 80 percent efficiency in converting raw energy inputs into usable energy for industry, that would save another 550 TBTUs. But among the four sectors of energy demand in California, that is the most hypothetical example. Electrifying California's industrial sector, or in any way increasing its overall efficiency in energy use, is something that should be left to businesses to decide based on cost/benefit. The replacement technologies currently proposed simply have not moved beyond experimentation.

When evaluating our state's official energy efficiency and electrification strategy, we must recognize that the costs and impacts will rise as our total energy requirements grow - something we cannot predict - as well as by however much we exclude practical and proven solutions.

It is not cost-effective or practical to mandate electrification of California's economy, nor is it cost-effective or practical to significantly improve the energy efficiency that we have already achieved. Even in the case of transportation, which consumes nearly half of our state's energy inputs and converts it at the lowest efficiency, mandating EVs fails to take into account enormous costs to modify infrastructure, an incomplete understanding of how to recycle and reuse batteries, and massive resource consumption that cannot be sustainably scaled in the event of widespread adoption.

Can Renewables Supply Abundant Affordable Electricity?

According to data from the California Energy Commission, in 2023 our in-state electricity generation totaled 210,272 gigawatt-hours. Another 65,517 gigawatt-hours were imported from other states. Of our in-state capacity, here are the significant producers: 43.7 percent came from natural gas, 8.2 percent from nuclear, 12.6 percent from "large" hydro (over 30 megawatt systems), 2.3 percent from biomass, and 5.1 percent from geothermal. Wind contributed 6.5 percent, and solar contributed 19.2 percent.

Under the 2022 CARB Scoping Plan, "Energy and Technology Transitions" are discussed on page 8. They set a goal of 500,000 gigawatt-hours of electricity production per year for 2045, while claiming that to achieve this "we need to keep all options on the table." But the centerpieces of their plan are to increase solar and wind generation by 4X, renewable hydrogen by 1,700X, and restrict sales of new cars to 100 percent ZEV (zero emission vehicles) by 2035.

There are inherent problems with this, starting with the fact that renewable hydrogen can only be produced through electrolysis, which requires electricity. Similarly, zero emission vehicles typically either run directly on electricity from onboard batteries, or their electric motors get electricity from an onboard fuel cell which converts hydrogen into electricity. Therefore to increase California's supply of renewable hydrogen by three orders of magnitude using electrolysis will greatly increase our target for electrical generating capacity.

Hydrogen may burn clean, but it is not a very efficient energy carrier. Thirty percent of the energy input is lost converting electricity into hydrogen using electrolysis, another 10 percent of that energy is lost compressing the hydrogen into a practical storage volume, and another 30 percent of that energy is lost when a fuel cell is used to turn that hydrogen back into electricity. Using a hydrogen fuel cell means that if you start with 100 kilowatt-hours, you end up with 42 kilowatt-hours; 58 percent is lost.

The ambitious plans to expand production of "renewable hydrogen" by "1,700X" within CARB's scoping plan merely confirms that 500,000 gigawatt-hours of electricity generation per year would be the bare minimum capacity needed to achieve the state's goals of mandated EVs and massive expansion of hydrogen production. But how will that happen with wind and solar? In 2023 California generated 41,344 gigawatt-hours of electricity from solar (nearly all of it from photovoltaics), and another 13,920 from wind turbines. Together that is an impressive 55,264 gigawatt-hours. And if you quadruple that, you now have an even more impressive 221,056 gigawatt-hours.

Which still begs the question: Where are the other 278,944 gigawatt-hours going to come from? We can add to that 4X wind and solar expansion some, but not all, of the other existing sources of electrical generation. According to the state's official energy goals, natural gas power generation will have to go. These closures will take 94,192 gigawatt-hours off the table.

California's last operating nuclear power plant, the embattled Diablo Canyon, generated 17,714 gigawatt-hours, but that could be shut down within a few years. Hydroelectric power (large and small scale), contributing 31,919 gigawatt-hours, will likely remain on the grid, but capacity is not likely to increase, and in fact, 2023 was an unusually productive year because of heavy rain. In 2022, large and small hydro combined only generated 17,612 gigawatt-hours, barely more than half 2023's production.

If we assume our sources of electricity generation will not include natural gas, and we assume neither an expansion nor a decline in nuclear and hydroelectric power generation, that would mean 21 percent of our current electrical capacity - nuclear and hydroelectric - cannot be increased, and 44 percent - the natural gas portion - is going to go away. Apart from wind and solar, what's left? There is only limited potential for biomass expansion, which generated 5,037 gigawatt-hours in 2023. Geothermal is a wild card, already delivering 10,999 gigawatt-hours in 2023.

Given the state's official target capacity by 2045 is 500,000 gigawatt-hours of electricity generation per year, then a 4X expansion of wind and solar contributes 221,056, and retaining existing nuclear and hydro capacity provides between 30,000 and 45,000 gigawatt-hours (depending on rainfall, which makes hydroelectric power unpredictable). That means we are still short by roughly 250,000 gigawatt-hours per year.

Understanding this fact puts California's official goal to significantly increase electricity production while relying on renewables into a more realistic perspective. Even if we expand wind and solar by 4X, and keep our hydroelectric dams and our one nuclear power plant operating, we are only going to generate about one-half of the electricity that the current government 'plan' says we will need.

The Potential of Biomass and Other Forms of Waste-to-Energy

In California, all waste-to-energy potential is bounded by the amount of feedstock available. Low to mid-range estimates of California's capacity to produce waste-to-energy feedstock, expressed in dry tons, are as follows: forest materials, 10 million tons per year; agricultural waste, 10 million tons per year; municipal solid waste, 20 million tons per year. These feedstocks are often more effectively used for co-generation, or refined into syngas for industrial applications. But it's useful to know how much electricity they could produce.

Using very rough numbers, 0.5 megawatt-hours of electricity can be generated per dry ton of municipal solid waste, and 1.0 megawatt-hours can be generated per dry ton both from forest materials or from agricultural waste. This means that ten million tons of forest materials at 1.0 megawatt-hours per ton will provide 10,000 gigawatt-hours of electricity. The same amount is available from agricultural waste. Municipal solid waste at twice the volume and half the energy density – 20 million tons at 0.5 megawatt-hours per ton – also provides 10,000 gigawatt-hours of electricity.

If fully realized, and applied 100 percent to electricity generation, California's annual waste stream could therefore contribute about 30,000 gigawatt-hours per year to our state's electricity grid.

The cost to process 40 million tons of waste streams per year purely to generate electricity is in most situations prohibitive. But more biomass power plants co-located with new sawmills might be part of a broader effort to start thinning our forests again to reduce the severity of wildfires and extract lumber. Using emerging technologies to convert municipal solid waste into syngas or co-gen energy might cost-effectively generate power while taking pressure off our landfills.

But one thing is certain: 30,000 gigawatt-hours per year, which is an optimistic projection for electricity generated from waste-to-energy feedstocks, does not make much of a dent in California's ultimate energy production needs.

The Potential of Geothermal Energy

According to the U.S. Bureau of Land Management, California has "two of the largest geothermal reservoirs in the United States, the Salton Sea resource area and the Geysers, with an estimated generation capability of 2,200 MW and 1,800 MW respectively." The Geysers geothermal field covers 45 square miles primarily in Lake, Mendocino, and Sonoma counties in Northern California. The Salton Sea is a 350 square mile, below sea level lake in Southern California that spans southern Riverside and northern Imperial counties. From these two areas the BLM estimates 4 gigawatts of baseload power potential, which is equal to 35,000 gigawatt-hours per year.

It is possible additional geothermal fields will be discovered. A 2014 analysis conducted by the Geothermal Energy Association estimated the upper potential of California's geothermal fields at 5.3 gigawatts, which at 100 percent capacity would produce 47,700 gigawatt-hours per year. A 2009 analysis by the US Geological Survey estimated the western United States had undiscovered geothermal resources totaling 30.0 gigawatts in addition to 9.1 gigawatts of known geothermal potential. Together at full output they would equal 342,428 gigawatt-hours per year, but the study area included 9 states, including the area covered by Yellowstone. We may indeed someday import geothermal generated electricity from Wyoming, but it is unlikely we're going to bottle up Old Faithful.

If we restrict the discussion to in-state electrical generating potential, geothermal is a wild card, with a potential contribution that remains uncertain. A geothermal field is being investigated in Modoc County in California's northeast. New aerial survey technologies are being used to map geothermal resources around the Salton Sea and elsewhere in the state. Geothermal electricity fully developed might rise as high as 50,000 gigawatt-hours per year, but even these most optimistic scenarios nonetheless relegate it to only making an incremental contribution to California's total energy targets.

Offshore Wind - An Environmental and Financial Catastrophe

In July 2024 the California Energy Commission adopted a "comprehensive strategic plan" to develop offshore wind energy. It calls for 5,000 megawatts (5 gigawatts) of capacity by 2030, and 25,000 megawatts (25 gigawatts) of capacity by 2045. If this plan is realized, offshore wind will generate an estimated 87,600 gigawatt-hours per year.

But there are significant obstacles to achieving this, starting with the fact that the plan calls for floating offshore wind platforms approximately 20 miles off the California coast. These would have a 'tip height' - the height from the base to the tip of a blade - of 250 meters, roughly equivalent to an eighty storey skyscraper. This is an unproven and costly method, to put it mildly. And at 10 megawatts each, to get to 25,000 megawatts of capacity, we would have to deploy 2,500 of these massive floating towers and turbines.

In the context of energy, "capacity" is an often misunderstood word. The "nameplate capacity" of an individual wind turbine might be 10 megawatts, but that amount of electricity is only going to be generated when the wind is blowing and the system isn't down for maintenance. With intermittent sources of electricity generating technologies such as wind turbines, the "yield" is what matters, and even offshore, that is unlikely to ever exceed 40 percent.

Taking into account intermittency, the U.S. Energy Information Administration estimates a construction cost for offshore wind of $10 million per megawatt. But that estimate is for the less expensive "fixed bottom offshore wind with monopile foundations," and not for floating platforms. According to economist Jonathan Lesser, author of The False Promises of Offshore Wind, "the technology for the cabling needed to secure the turbines to the floor and the cables to carry the electricity are in their infancy. The EIA estimate for floating turbines is, in my view, pure fantasy." Which is to say, more than $10 million per megawatt. Another expert is Gordon Hughes, a professor of economics at the University of Edinburgh. For the last several years he has been analyzing the performance of offshore wind in the North Sea and throughout the world. Here is his assessment of floating offshore wind off the California coast:
"I don't believe the figures given by EIA – they have no basis in actual costs and performance, they are little more than optimistic guesses generated by lobbyists. No-one knows how to build floating wind turbines with a tip height of 220 or 250 meters. The rotational forces in high winds are huge and the only way to stabilize them is to build huge concrete/steel platforms. I have no idea where they would be built on the West Coast and I doubt that towing them across the Pacific from East Asia is viable. Could they transit the Panama Canal? The point is: all talk of floating wind farms off California or Oregon seems to me to be ungrounded speculation. You could build ones with a tip height of 150 meters but that would significantly reduce both the nominal capacity and capacity factor for such turbines."

At that lower height, still nearly 500 feet, nameplate capacity is only 2.5 megawatts per turbine. We would have to float 10,000 of these smaller wind turbines in order to achieve the currently planned 25 gigawatt capacity off our coast.

As acknowledged in a Cal Matters report from July 2024, "The offshore wind industry must be created almost from scratch: a new manufacturing base for the still-evolving technology; a robust and reliable supply chain; transportation networks on land and sea; specially configured ports to make, assemble and maintain the gargantuan seagoing platforms; finding and training a highly specialized workforce; building a large transmission network where none exists and beefing up those that operate now."

Imagine if California's plans to install between 2,500 and 10,000 floating offshore wind turbines approximately 20 miles off the coast of San Luis Obispo and Humboldt counties ever comes to full fruition. To produce 25 gigawatts of capacity would require at least 2,500 wind turbines floating approximately 20 miles offshore. To have a capacity per turbine of 10 megawatts, each of them would need to be approximately 1,000 feet high, roughly the height of the Eiffel Tower, and each of them would have at least three tethering cables hooked to the sea floor over 4,000 feet underwater. Each of them would also need an underwater high voltage cable that would somehow connect to the onshore grid.

The estimated cost to install 25 gigawatts of capacity, which equates to 10 gigawatts of steady power if adequate storage assets are available, is at least $100 billion. Those costs don't include the necessary investments in storage assets or additional high voltage transmission lines. Nor do they include the costs to maintain these floating turbines in a hazardous environment, or the cost to industrialize California's pristine coast to establish staging and maintenance facilities. All this, for 87,600 gigawatt-hours of electricity per year. Assuming the California's zealous Coastal Commission - AWOL so far on this - allows anything offshore to go forward. And none of this is to even mention the disruption to and destruction of marine ecosystems and our environment more generally.

California's proposed floating offshore wind projects epitomize the insanity of California's overall energy strategy, in all its aspects. It is a stupefying waste of resources, not only for the monstrous floating wind turbines themselves, but for the high voltage transmission lines necessary to traverse the seafloor and the coastal mountain ranges, the battery farms, and the shore facilities including harbors and maintenance shops. There is the environmental impact in the air and underwater; the destructive spinning blades, the obstructive tethering cables and anchors, the ubiquitous noise, and the electric fields produced by the underwater power cables. And then there is the cost; hundreds of billions of dollars for systems that will require frequent maintenance including turbines that may require replacement every ten years in the harsh marine environment.

Floating offshore wind is an absurd proposition. If it is implemented it is guaranteed to become a colossal and destructive waste, and yet it perfectly exemplifies everything that is wrong with California's current energy policy.

Onshore Wind Development

California's Joint Agency Report of 2019 anticipates a near tripling in onshore wind energy generation capacity. In 2022, onshore wind generated 14,607 gigawatt-hours. This is planned to increase to just over 40,000 gigawatt-hours by 2045. Wind, onshore or offshore, just like solar photovoltaics, is an intermittent form of power generation that requires backup storage in order to provide reliable electricity. Also, wind energy farms have to be sited in areas with strong, steady wind, which are usually not areas that are close to existing high voltage transmission lines. These additional expenses have to be taken into account when evaluating wind generated electricity as an option, but according to the US DOE, and based on data from what is by now a well established industry, onshore wind energy is about half as expensive as offshore wind.

What may hinder the planned tripling of onshore wind capacity in California are the environmental impacts which are finally attracting growing concern. Wind turbines not only kill raptor birds like eagles and falcons which are at the top of the food chain, but also insects which are at the foundation of the food chain. From Windwatch.org, "The vast amount of avian and insect deaths at the hands of wind turbines is disastrous in and of itself, from a conservation and ecological standpoint. Equally concerning, however, is the serious downstream effect upon crop production and the global food supply, especially at a time when farmers and agricultural producers are suffering from stringent environmental, social, and governance (ESG) score mandates. The most direct link between wind turbines and declining food production is the aforementioned reduction in pollinator insects, which will lead to less crop yields. A secondary link is that the declining insect populations will reduce the food available for other animals, many of which are relied upon for food as well."

In addition to causing harm to wildlife, wind turbines have a visual impact, and a noise impact. They also require a lot of land. The Tehachapi Wind Resource Area is one of California's best sites for wind turbines. By using Google satellite imaging to observe fully developed sections of this area, the rows of 1.5 and 3.0 megawatt turbines appear to average around 20 per square mile. Making this assessment is an inexact science, but even if all of them had a 3.0 megawatt capacity, at a typical onshore yield of 25 percent, they would generate 131 gigawatt-hours per square mile per year. That means to supply 40,000 gigawatt-hours per year by 2045 using land based wind turbines would require 304 square miles. To be fair, this isn't very much compared to the total area of California. But the environmental impact cannot be dismissed, particularly since windy passes are also migration routes for insects.

Photovoltaics

California's energy planners are relying on utility scale photovoltaics as the primary future source of clean energy in the state, growing from 40,494 gigawatt-hours in 2022 to a planned 180,000 gigawatt-hours per year by 2045. Solar's primary weakness is not just its daily intermittency - i.e., when the sun goes down, photovoltaic output ceases - but the fact that, even in subtropical California, it varies significantly by season.

For example, in 2023, California's installed base of utility-scale photovoltaics had an output capacity in full sun of 19.9 gigawatts, and produced 39,422 gigawatt-hours of electricity, an actual yield of 22.6 percent. But the month-to-month amount of photovoltaic power generation was uneven. The yield was only 15 percent in December, when the days were both short and often cloudy. In June, by contrast, when the days were long and clouds were scarce, the yield was 37 percent, 2.5 times greater.

Daily intermittency can be solved with batteries and other forms of hourly storage. But so-called long-term storage is much harder to deploy, if it is even possible. With only hourly storage available, daily fluctuations can be managed, albeit at great expense. Seasonal fluctuations, by contrast, require either overbuilding solar capacity to guarantee adequate winter output, or using other forms of replacement power generation during the winter.

The space required for solar is less than some detractors claim. At 12.5 watts per square foot, a yield of 25 percent, and allocating 50 percent additional land for space between the panels, access roads, substations, and new transmission connections to the grid, it would require around 524 square miles of photovoltaic panels to generate 200,000 gigawatt-hours of power. Depending on how you look at it, that may seem like a lot of land. But considering California has 156,000 square miles of land area, there's probably room.

An additional, and highly significant source of photovoltaic power in California, however, uses almost no land - because most of it is on rooftops. According to the Joint Energy Report of 2021 (ref. "Summary," page 7), in 2019 residential solar capacity was an estimated 8.0 gigawatts, which at a yield of 25 percent would have delivered another 17,500 gigawatt-hours of electricity. It is hard to get accurate information on the amount of so-called "inside the meter" private installations, but by 2024 the total capacity has been estimated at over 12 gigawatts. The Joint Energy Report predicts that by 2045 this capacity will rise to 28.2 gigawatts, which would contribute 62,000 gigawatt-hours per year to California's electricity supply.

It is possible that these decentralized photovoltaic installations could yield much more. According to a NREL study conducted in 2016, there were just over 10 billion square feet of usable rooftop space in California for solar. Massive warehouse construction and ongoing construction of all types – even a few homes – since then mean this number has only increased. But 10 billion square feet, at 12.5 watts per square foot and a 25 percent yield means if 100 percent of California's usable rooftop space had photovoltaic arrays, it would generate 273,750 gigawatt-hours, nearly equivalent to California's entire 287,220 gigawatt-hours of electricity consumption in California in 2022.

Decentralized rooftop photovoltaics could be a huge opportunity. Adding parking lots and other viable private acreage to the pool of available space indicates that non-utility, decentralized, private installations of photovoltaics have the potential to greatly reduce the ultimate land footprint of utility scale solar farms.

No discussion of photovoltaics, however, should ignore several additional cautionary factors. Utility scale solar farms often end up displacing farmland, and even when situated in desert environments, they transform these fragile ecosystems in ways that environmentalists typically do not tolerate. There is also the heat island impact of photovoltaics, which is negligible on a rooftop that is already a heat conductor, but can have a significant impact on regional temperatures when covering several square miles of farmland. For example, a solar farm next door to an almond or pistachio field reduces the 'chill hours' - the total amount of time that temperatures fall below a certain level - that tree nuts need to grow.

There is also the inconvenient fact that photovoltaic panels are manufactured primarily in China, where there are minimal labor protections or environmental safeguards. Many solar panel factories are powered by energy from coal-fired power stations.

However, if photovoltaics were manufactured in America, the costs would increase. Finally, photovoltaic panels only have a useful life of around 20 years, and there is still no cost-effective process to recycle and reuse them.

While photovoltaics may be preferable to wind energy as a renewable technology that can affordably scale, California's official assessment of their viability tends to emphasize their strengths and ignore their liabilities, both environmentally and financially.

Storage Technologies

The California Independent System Operator (CAISO) is an independent non-profit that oversees California's electric power system, transmission lines, and the electricity market generated and transmitted by its member utilities. Its member utilities serve 32 million people, managing over 26,000 "circuit miles" of transmission lines. In 2023 it delivered through its system 237,500 gigawatt-hours of electricity, over 80 percent of California's total electricity consumption.

Every day, CAISO reports electricity supply and demand by hour. For example, on August 14, 2024, a typical summer day, renewable output increases when the sun comes up, starting from an all night low averaging around 6 gigawatts, 80 percent coming from wind turbines with geothermal, biomass, and small hydro providing the rest. By 9 a.m. thanks to the contribution from solar, total renewables output hits 20 gigawatts, peaking around 3 p.m. at 25 gigawatts. As the sun sets output drops quickly, falling back to around 6 gigawatts by 7:30 p.m. and staying there until morning and the cycle repeats itself.

Demand, on the other hand, has a different daily curve. On that same day California's electricity demand was flat at around 27 gigawatts from 6 a.m. till noon, then rose on a gradual slope to hit 32 gigawatts by 2 p.m., 37 gigawatts by 4:30 p.m., then peaking at nearly 38 gigawatts at 6:30 p.m. It then fell gradually, still drawing 37 gigawatts at 8:30 p.m., then steadily falling to a low of 25 gigawatts around 4 a.m. And then the cycle repeats itself.

It's easy enough to see the challenge this presents. With more solar and wind capacity being added every month, battery storage must keep pace. Most utility scale storage battery capacity is reported in megawatts, with the typical discharge period lasting four hours. Some batteries can hold a six hour charge but those are just beginning to come available. As it is, on 8/14 California's battery farms began to absorb surplus renewable electricity at 7 a.m., peaking at 6 gigawatts of charging from the hour of 9 a.m. until around noon, then continued to charge until around 2:30 p.m. From that point on they began to discharge stored electricity onto the grid, with peak discharge of 8 gigawatts at 8 p.m.

This profile varies from day to day, and more significantly from summer to winter. California's utilities have made significant increases to battery storage capacity in just the past few years. According to the California Energy Commission, battery storage in 2024 totals 10.4 gigawatts, including 1.1 gigawatts reported as private residential, and 0.6 gigawatts as private commercial.

By 2045, the state aims to expand total battery storage to 52 gigawatts, which if these batteries still have a four hour charge/discharge cycle, equals 208 gigawatt-hours of daily cycling. As will be seen, this may be more than enough.

The challenge with batteries, as with all renewables, is that the state downplays the downsides. Lithium ion battery technology still has not reduced the risk of fires from "thermal runaway." These batteries require cooling systems to keep their temperature down, and when those systems fail, the explosive fires that result cannot be extinguished but have to be allowed to burn until the fuel is exhausted. This was most recently demonstrated in a horrific fire that consumed an entire 300 megawatt battery farm (the world's largest) located at Moss Landing on Monterey Bay. Lithium ion batteries also require large amounts of not only lithium, but cobalt, manganese, nickel, and graphite, and many of these essential minerals are imported from mines around the world that are owned by China. These batteries therefore carry a huge environmental impact in their manufacture, and their continued availability at a reasonable cost is subject to geopolitical risk.

Once again, these risks are ignored by California's energy policy-makers. Imagine the cost if the materials for these batteries were mined in the United States, and then manufactured in California. The very idea is intolerable to California's environmentalist community, or the energy bureaucrats they've put in charge of our energy future.

Zero Emission Electric Vehicles

According to the Department of Motor Vehicles, there are 30.8 million cars and light trucks currently registered in California. According to the U.S. Department of Energy, of these, 1.2 million are "BEVs," that is, pure battery-electric vehicles and not including hybrids that combine gasoline and electric propulsion. Almost all of California's BEVs (more commonly just referred to as EVs) were sold in the past five years, with 374,000 sold in 2023. An overwhelming 60 percent of BEVs sold were Teslas; 226,000 in 2023. The closest rival to Tesla was Chevrolet, selling 19,000 BEVs in the state, followed by Ford, Mercedes, and Hyundai, each of these three companies selling 16,000 BEVs.

The state has set a goal of eliminating all sales of new, non-BEVs by 2035. This destroys any incentive for innovation in regular or hybrid vehicle technology, and denies consumers a choice. Could the government mandate ever be achieved voluntarily? One might argue that everyone who wants to own a BEV has already bought one. Sales records have been broken every year, but growth in 2024 vs 2023 was less than 2023 vs 2022, and market share is still under 5 percent. That's too early for year-over-year rates of growth to slacken unless something's wrong. Why did Hertz sell off a third of its BEVs? Why did Ford cut back production of its BEV F-150? Why were Tesla sales down 10 percent in Q4 of 2023 compared to Q4 of 2022?

Another challenge will be whether or not California can actually manage to increase the number of public quick-charge stations from the current 93,000 to over 1 million by 2030, and over 2 million by 2035.

Will solid state batteries and other emerging technologies arrive, allowing charge times of under 15 minutes in exchange for ranges over 500 miles? How else will Californians be induced to voluntarily purchase BEVs in numbers ten times what we've seen so far? Because that's what it's going to take to get to just a 50 percent share of BEVs on the road, let alone 100%.

Something that doesn't figure prominently in state planning documents is the potential of BEVs to serve as additional electricity storage assets. They could charge from the grid during the daily surge of photovoltaic supply, but fully charged vehicles could then supply power to the grid during peak demand. This technology is referred to as V2G (vehicle to grid) and is also being explored as V2B (vehicle to building) and V2V (vehicle to vehicle). Power your home during a blackout? Rescue and recharge a stranded EV in a remote location? But the economics would have to be worked out to incentivize EV owners to send power back upstream. Charger units would require upgrades, and vastly decentralized grid management would become even more complex. Finally, participants would see their EV charge/discharge cycles increase, shortening the life of their battery. But the storage potential is huge.

The total vehicle miles traveled by Californians each year is estimated at 340 billion. At an average EV efficiency of 4.5 miles per kilowatt-hour, converting 100 percent of California's automotive fleet to EVs would require an additional 113,000 gigawatt-hours of electrical generation per year. Here's the upside: If every one of California's 15 million automobiles was an EV that got 4.5 miles per kilowatt-hour with a 250 mile range, the combined fleet would have a storage capacity that boggles the mind, over 800 gigawatt-hours. Even at a 10 percent market penetration of EVs, 80 gigawatt-hours of on-board storage would be available statewide. If V2G technology were perfected and made standard, it could reduce or even eliminate the need for utility scale stationary battery farms.

Anyone who has experienced the acceleration of an EV can appreciate this is a vehicle technology with potential, just as anyone who has driven an EV through a snowstorm with only 10 percent of their battery charge remaining can appreciate this is a vehicle that is not going to be right for everyone. California has no business mandating EVs. Let people choose.

And, lest we forget, the environmental impact of EVs is not benign. According to the International Energy Agency (IEA), the average EV requires over 200 kilograms of valuable minerals including copper, lithium, nickel, manganese, cobalt, graphite, zinc, and other rare earths, mainly for the battery. A conventional automobile averages just over 30 kilograms of these valuable minerals, mostly copper and manganese. An EV requires about seven times as much mining and smelting compared to the average car.

Overall, conventional power plants using gas, nuclear and coal, require one-tenth or less raw materials to generate an equivalent quantity of electricity as solar or wind. For modern natural gas combined cycle generating plants, the ratio is closer to 1/20th as much raw inputs as solar or wind.

But when it comes to solar and wind power, which is distributed and intermittent, what about the transmission lines and the batteries? What about the service life of all this installed base, the solar panels and batteries and wind turbines that degrade after 20 years and have to be decommissioned, recycled and replaced? What about the environmental costs of extending this resource guzzling scheme to every nation on earth?

Summarizing the Potential of Renewables

As noted in the Introduction, on page 162 of CARB's "2022 Scoping Plan Update," they estimate total electricity consumption to rise to nearly 500,000 gigawatt-hours by 2045 from current consumption, which in 2023 was 281,140 gigawatt-hours. But as documented in the preceding sections, California cannot possibly expect to generate 500,000 gigawatt-hours by exclusively relying on renewables. Here is a recap:

The largest source of additional utility scale power generation is supposed to come by quadrupling the output of wind and solar from the 2023 in-state total of 55,264 GWH to 221,056 GWH. That quadrupling in wind and solar output includes a planned contribution from floating offshore wind of 87,600 GWH. But floating offshore wind is a prohibitively expensive and environmentally destructive option that must never come to fruition.

Another significant source of renewable electricity that qualifies under California's current plan are the "inside the meter" private photovoltaic arrays owned by homes and businesses. The Joint Energy Report predicts that by 2045 this capacity will rise from approximately 13 gigawatts today to 28 gigawatts. The incremental increase (inside-the-meter production is not included in the state's estimates of electricity consumption) would contribute 33,000 gigawatt-hours per year to California's electricity supply.

Other sources of renewable electricity include geothermal, which in an absolute best case may provide 50,000 GWH, and biomass which could possibly fuel another 30,000 GWH.

So altogether, the current and projected renewables favored by CARB add up to 334,056 gigawatt-hours, which is only 67 percent of their goal of 500,000 GWH. By retaining large hydro and keeping Diablo Canyon nuclear power plant open, which, in the best-case scenario adds 45,000 more gigawatt-hours per year, the total rises to 379,056 GWH. This is still only 76 percent of the stated 500,000 GWH per year goal.

We find it implausible that even this can be achieved under the current plan, and in the current political environment. It assumes nuclear power will not be shut down. It assumes all biomass resources are used to generate electricity, with none allocated instead to produce combustible fuel. It assumes a massive investment in geothermal power, tapping resources that aren't yet proven. It assumes either successful development of floating offshore wind, which should be ruled out, along with a 4X increase in new onshore wind and photovoltaic developments.

Even in this scenario, is it cost-effective or environmentally responsible to quadruple California's onshore wind and photovoltaic capacity, along with the required batteries to make it work? California's energy bureaucrats are assuming every challenge can be resolved: the cost, the safety, the environmental impact, the geopolitical risk, the environmental impact in sourcing, installing, and recycling...This is destructive, delusional thinking.

The practical way to ensure affordable, reliable electricity that also protects our environment is obvious, and so easy it's remarkable that it is being ignored. We need to keep our natural gas generating plants, and add nuclear generating capacity. By doing this, the goal of achieving abundant electricity suddenly becomes entirely feasible. As we will see, if California's natural gas power plants were permitted to provide constant baseload power, instead of only being turned on when the sun goes down and the wind stops blowing, the existing fleet could generate 300,000 gigawatt-hours per year, more than our current total consumption and on its own nearly two thirds of the supply that current policy is targeting for 2045. Adding two new large nuclear power plants and keeping Diablo Canyon open would easily contribute another 50,000 gigawatt-hours. Existing hydro-electric, geothermal, and biomass adds another 50,000 gigawatt-hours, bringing total electrical capacity to 400,000 gigawatt-hours. Expanding capacity beyond that with the many options available suddenly becomes easy.

The biggest prize, therefore, is simply to retain our fleet of natural gas power plants, allow them to run as baseload power producers, and upgrade or replace them as necessary so they adhere to the most advanced, ultra-efficient, ultra-clean technologies. Doing this creates the best possible pathway to electricity abundance.

Proponents of practical energy strategies often use the term "all of the above" to characterize their recommendations. This is a misleading cliche. We don't want "all of the above." We reject offshore wind categorically. We condemn biofuel as an obscene waste of land and resources. We question whether or not battery storage or even battery powered EVs can ever be produced at scale without stripping the earth of resources. We question the environmental sustainability of utility scale solar as well as land based wind energy solutions.

Notwithstanding the destructive environmental impact of most renewables (at least as bad as, if not worse than the impact of conventional natural gas, nuclear, and hydroelectric power), there is the cost. An "all of the above" energy strategy is only a useful concept insofar as it permits an objective assessment of all energy solutions without falling prey to the limiting constraints of 'climate' dogma. Surely our energy policy should be governed by practicality, not ideology? California's prevailing state energy policies are incoherent, self-defeating and insane. They deny their own inherent environmental and financial lack of sustainability, yet are forced down the throats of every Californian regardless of cost.

These policies extend to an all out war on California's gas and oil production, refining, distribution, and consumption. This war is being waged by our state leaders with complete disregard for the economic consequences harming Californians, and in blind indifference to the environmental destruction and human misery they are exporting abroad.

California's state-sponsored war on gas and oil

In April 2021 Governor Newsom directed CARB to develop a strategy to phase out oil extraction across the state by 2045. Also part of CARB's "scoping plan" to achieve carbon neutrality by 2045 is a phasing out of natural gas. California will ban the sale of new natural gas fired space heaters and water heating appliances by 2030. California has also committed to eliminating most of its more than 200 utility scale natural gas power plants by 2045, although, embarrassingly enough, to meet electricity demand they have had to keep plants open that were scheduled for closure.

As previously noted, California derives 50 percent of its raw energy input from petroleum and 30 percent from natural gas. And although California has eliminated coal from its fuel mix, its 80 percent dependence on fossil fuel, despite years of efforts to reduce it, is almost exactly the same as the world, at 82 percent.

California's Embattled Oil Industry

As recently as 2012, California was still the nation's third largest producer of oil, behind only Texas and North Dakota. But California's oil production had already been declining for decades. The peak year was 1985, when nearly 394 million barrels were extracted from California wells. At that time, nearly two thirds of California's oil demand was fulfilled by in-state supply, with most of the rest coming from Alaska. Foreign imports were almost negligible.

Today California's oil production is down to less than one-third of what it extracted in the 1980s. Only 118 million barrels were produced in 2023. But demand is only slightly down, from 644 million barrels in 1985 to 529 million barrels in 2023. Our production is down by 70 percent since 1985, but our total state demand for oil is only down by 18 percent. Meanwhile, we have reduced imports from Alaska by 60 percent, and our imports from foreign nations have increased by an astonishing - and outrageous - 800 percent. We import 77 percent of the oil we consume. While some of that comes from Alaska, 61 percent of the oil we consume comes from foreign suppliers, most of them in the Middle East.

It should be emphasized that reducing oil exploration and drilling in California does absolutely nothing to help the global environment, or "fight climate change", if we simply source our oil from somewhere else.

While reliable data on remaining oil reserves in California is not readily available, just within the Los Angeles basin lies an estimated 1.6 billion barrels of recoverable oil. A 2011 analysis from the US Environmental Information Agency estimates the state's recoverable reserves at 2.3 billion barrels, but industry experts have estimated California's commercially recoverable reserves are probably closer to 5 billion barrels. If shale oil is taken into account, California's oil reserves increase substantially. A study commissioned by the US EIA in 2011 estimated "The largest shale oil formation is the Monterey/Santos play in southern California, which is estimated to hold 15.4 billion barrels." Not incidentally, the report estimated the quantity of recoverable natural gas contained in shale formations in California at 41.4 trillion cubic feet.

The emissions from operating wells in the Los Angeles basin, allegedly beyond any possibility of mitigating, are not comparable in volume or toxicity to the emissions from tankers that linger offshore to supply crude oil to California's coastal refineries. Maritime transport still relies on bunker fuel, cheap bulk fuel that is the least refined and dirtiest of all petroleum based fuels. The prevailing Pacific winds typically blow this pollution spewing from oil tankers directly onto the mainland. Moreover, moving crude oil from far flung sources around the world to California's refineries released an estimated 1.7 million metric tons of CO2 into the atmosphere last year. All of this could be avoided if California's domestic oil industry, the cleanest in the world, was allowed to operate and continue to extract oil from in-state wells.

The laws and regulations involved with California's ideological goal to eliminate oil in California are too numerous to cite, but the result is clear: a 70 percent drop in production with no end in sight. One of the most recent laws is worth highlighting because it could spell the end of the industry. This is Senate Bill 1137, signed by Governor Newsom in 2022. It creates "health protection zones" within 3,200 feet of any "sensitive receptor," i.e., any establishment open to the public or any residence. Fighting for its life, the industry qualified a referendum on SB 1137 that was going to be on the state ballot in November 2024, but in June the oil industry groups behind the referendum withdrew the referendum in order to pursue a legal strategy instead.

The reasons for this were clear enough. As quoted in Cal Matters, the Chairman of the California Independent Petroleum Association said "Supporters of the energy shutdown can make unfounded claims in the press and in paid advertisements, but they can't make those claims in court without evidence."

With the referendum off the ballot, however, the injunction it imposed on the implementation of SB 1137 has been lifted. Unless a court intervenes, the bill takes effect. The practical impact of this is not only to ban most future drilling, but also impose restrictions (and invite lawsuits) that will compel shutdowns of existing wells. The alleged problem is air quality affected by methane leaks. But methane is lighter than air, meaning whatever leakage may occur at any of California's strictly monitored wells will quickly dissipate upwards. How much of a health hazard is actually posed by wells within 3,200 feet of occupied buildings is going to be settled in court.
Meanwhile, California's legislative and regulatory attempts to shut down its own oil industry continue.

California's Embattled Natural Gas Industry
The other fossil fuel, natural gas, was once considered by environmentalists to be an acceptable "transitional" fuel as we marched towards a future that promised unlimited nuclear fusion power. After all, for those who care deeply about such things, natural gas produces a much lower ratio of CO2 emissions per energy output than oil. Currently representing 30 percent of California's raw energy input, retaining a role for natural gas ought to be beyond debate. Instead, the State of California has determined it must be eliminated. This is insane.

As we have seen in the previous section, if natural gas power plants were fully utilized in California instead of being limited to intermittent operation to fill in when renewables falter, electricity production in California could easily be increased and made affordable. Furthermore, retaining natural gas as an available option for heating and cooking is obviously a reasonable objective - not only because it would keep those human essentials affordable, but because many people prefer natural gas heaters and cooktops, and find their electricity-powered counterparts impractical and annoying. It is hardly an outlandish demand to ask that the government allow people to choose how to heat their homes and cook their food.

In relation to electricity generation, natural gas can be retained for use in power plants with advanced combined cycle designs that are now capable of reaching efficiencies of 70 percent, with new emerging technologies that could raise that to 80 percent.

Natural gas can be used to rapidly increase production of electricity merely by changing how the plants they fuel are operated. For example, California's natural gas power plants produced 94,192 gigawatt-hours in 2023, equal to 44 percent of California's total in-state production. But for the most part, they were only operated at 27 percent of their capacity, because so many of them were only run when solar and wind generated electricity was not available. If these plants were permitted to run at 90 percent of their capacity, which is not unusual for a natural gas powered plant providing 'baseload' power instead of intermittent power, they could have generated 312,861 gigawatt-hours, an increase of 218,669 gigawatt-hours.

It is important to acknowledge that many of California's natural gas power plants are older designs and that it may be more cost-effective to replace them than to retrofit them. This doesn't alter our recommendations. In fact, the construction costs for modern combined cycle natural gas power plants have fallen in recent years and are less expensive than solar or wind. The biggest driver of costs for natural gas (and nuclear) power generation, particularly in California, are regulatory impediments and litigation, not the actual cost of construction. Many of these are dealt with in previous Golden Together policy reports, for example on improving our business climate.

It should also be noted that extracting natural gas in-state and using it to produce electricity avoids the exposure that wind and solar components have to changes in the global supply chain, commodities prices, and foreign relations - all of which could cause those imported products to abruptly spike in cost, or disappear altogether.

There is no shortage of natural gas in California. Our state has plentiful reserves, and is networked via pipelines to the rest of the United States, which also has abundant reserves of natural gas. Until breakthrough energy technologies such as nuclear fusion power become available, natural gas must remain part of California's energy mix.

A Practical Energy Plan for California

California's official state energy 'plan' cannot achieve its goal of net zero by 2045 without creating unacceptable shortages, nor can it be achieved without subjecting Californians to an oppressive financial burden. The goal of 'net zero' is based on a theoretical outcome that may or may not happen, but the negative consequences of pursuing that goal are absolutely certain to occur. Equally obvious is the fact that other states are unlikely to follow California's lead, and other nations with much larger populations are undoubtedly not going to follow California's example. This reduces California's official energy strategy to performative symbolism, accomplishing nothing other than to spread misery, poverty, insecurity, oppression, and environmental havoc as land and sea are carpeted with toxic, resource guzzling monstrosities that have inexplicably been dubbed "renewables."

Our positive, practical proposal is to embrace electricity generating technologies that the current official plan either eliminates or minimizes, including natural gas and nuclear energy. We also believe the current timetable to eliminate production and use of petroleum is utterly incoherent, raising the cost of living for Californians while actually increasing carbon emissions. We propose a more sustainable alternative that preserves and even expands California's petrochemical industry until replacement technologies are widely available and chosen by people and businesses.

Our practical approach to energy planning will avoid shortages and high prices. The first element of our plan is to accept the official electricity generating goal of 500,000 gigawatt-hours per year by 2045. But we should aim to meet this goal through the expansion of existing generating technologies; in particular, natural gas and nuclear power.

Here are the factors that inform our endorsement of a goal of 500,000 GWH per year of electrical generating capacity in California:

- Per capita personal end-user energy use will increase.
- New technologies such as AI, crypto, robotics, along with power consuming innovations we cannot foresee, will elevate electricity demand.
- Abundant electricity will enable deployment of energy intensive infrastructure such as desalination plants.
- Electrolysis of hydrogen and processing synthetic fuel are examples of how large amounts of electricity may be required to produce large quantities of next generation thermal fuels.

To achieve 500,000 GWH of electrical generating capacity, we believe there are three options that can deliver hundreds of thousands of GWH each per year; natural gas, nuclear, and solar. While we may specify targets for each of these three categories, we believe the final mix should depend on how the technologies for each of them advance in the coming decades. It may be that one of these technologies becomes far more cost-effective than the others, in which case that will become the preferred choice.

We believe wind energy, which takes up more space than photovoltaics and has more negative environmental impacts, is not an energy solution that can be scaled up to the same degree as natural gas, nuclear and solar.

An Appropriate Mix of Electricity Generating Options

Here are our recommendations for affordable, reliable clean electricity generating capacity:

- Retrofit or replace California's existing fleet of natural gas power plants in order to achieve a 'baseload' generating capacity of 300,000 GWH per year. By 2045, upgrade or replace California's entire fleet of natural gas power plants using the latest combined cycle technology to run at 60 percent efficiency or more. Become a world leader in clean natural gas powered electricity, with a goal of building plants that can achieve up to 80 percent efficiency.
- Incentivize private property owners with a goal of decentralized electricity generating solar capacity reaching 100,000 GWH per year.
- Increase nuclear generating capacity to 50,000 GWH per year. This could be accomplished by constructing two more nuclear power plants with the capacity of Diablo Canyon, or through a mix of small and large nuclear power plants. We should also investigate the possibility of reviving output from San Onofre. Small modular reactor technologies may develop to the point where it becomes feasible to reach 50,000 GWH of nuclear capacity without building any new large nuclear reactors.
- Develop 25,000 GWH per year of geothermal capacity.
- Primarily through developing additional small hydro capacity, maintain a 15,000 GWH per year output of hydroelectric power.
- Increase biomass electrical production to 10,000 GWH per year. Site plants in close proximity to areas where responsible logging and forest trimming operations can be brought back to 1990 levels.
- Increase capacity to store intermittent sources of electricity through new pump storage facilities attached to new and existing reservoirs. Prioritize vehicle-to-grid technology for all-electric and hybrid vehicles so California's growing private fleet of EVs and hybrids can store and release energy to the grid. Doing this will save ratepayers billions of dollars, because it would dramatically reduce the need for utilities to invest in large-scale electricity storage.

Notable in this plan is that it does not require any utility scale solar, wind, or battery farms, and in fact, achieves the target 500,000 GWH per year without any role whatsoever for these technologies. This could mean, for example, that the utility scale solar and wind capacity that has been installed so far could operate until the end of its useful life, which would probably be around 2045, and no new installations would be needed.

If, on the other hand, these solar and battery technologies eventually become cost competitive and environmentally sustainable, our strategy does not restrict them from competing with other sources of electricity to bring prices down for consumers. But we do not foresee wind energy (onshore or offshore) ever becoming competitive in price or environmentally benign, and therefore do not envision a role for it in California's energy future.

A Realistic, Job Creating Plan for Combustible Fuel

Developing 500,000 GWH per year of clean electricity capacity will enable Californians to enjoy abundant and affordable electricity, opening up many options for increasing electricity consumption, but total electrification is not feasible or desirable. Here is the argument for retaining combustible fuels for more than electric power generation in California.

- The state currently consumes 7,000 TBTUs (Trillion British Thermal Units) of raw energy inputs; 80 percent of that total is accounted for by petroleum and natural gas. One third of the total is actually converted into energy services for end users - about 2,500 TBTUs.
- Generating 500,000 GWH of electricity inputs to California's grid, after transmission and conversion into heat, light, traction, communications and computing, etc., at 80 percent conversion efficiency (very best case), delivers 400,000 GWH of usable output, equal to about 1,300 TBTUs. That is only about half of the 2,500 TBTUs of energy services currently consumed by Californians.
- Filling this remaining gap of at least 1,200 TBTUs per year must address end user energy demands that even by 2045 will not be able to be met by electricity, but instead must use combustible fuels. These energy demands would include significant portions of aviation, aerospace, manufacturing, transportation, and many industrial and agricultural applications.

Even under a best case scenario, it is unlikely that more than half of California's energy consumption can be powered by electricity, and with 50 percent of California's raw energy inputs currently fulfilled by oil, there is zero probability that California will end its reliance on oil as an essential fuel by 2045. If such an 'energy transition' is ever to happen, it needs to be the result of choices made by people, and will most likely occur over the course of a century, not a mere twenty years. So the only real question is whether we will continue the current, idiotic government-mandated transition from domestic to imported oil and gas. We believe that as we move towards cleaner energy, it is in the interests of Californians as well as our environment to reduce imports and expand in-state production of oil. This will create jobs in California, and the environmental impact here will be minimized when compared to the process of oil extraction in and shipment from elsewhere in the world.

Recommendations

- Rescind the “net zero by 2045” energy policy and all executive orders, court rulings and legal precedents, agency regulations, and state laws pursuant to it.
- Require California's petroleum to be sourced in-state whenever possible, while adhering to the most responsible environmental standards in the world.
- Increase safe, responsible drilling for oil and gas in-state.
- Require minimum 50 percent domestic content for all energy, from gasoline to photovoltaic panels to batteries. That might stimulate a more realistic assessment of what is economically and environmentally sustainable.
- Repeal Governor Newsom’s executive order mandating pure EV sales for all new cars by 2035.
- Reverse existing incentives to encourage (but not mandate) at least two types of energy (for example, natural gas and electricity) to be deliverable to new residential or commercial buildings. This will improve resiliency in the face of shortages or natural disasters. It will also force competition between energy providers, lowering prices.
- Rename the “renewable portfolio standard” as the “clean portfolio standard.” Establish criteria whereby nuclear and natural gas power will be included in the definition.
- Retrofit or replace natural gas fueled power plants in order to attain the highest modern standards and technologies instead of eliminating them. Classify natural gas electricity generation that meets at least a 70 percent efficiency standard as eligible under the renewable (clean) portfolio standard. Permit natural gas power plants to operate continuously instead of limiting their operation to filling in when intermittent sources of electricity are offline.
- Declare an end to the moratorium on nuclear power. Classify nuclear power as eligible under the renewable (clean) portfolio standard.
- Require Power Purchase Agreements between utilities and energy producers to require pricing based on providing continuous baseload power, so that producers of intermittent electricity will have to invest in storage assets. This will ensure fair competition with conventional energy producers.
- Recognize that offshore wind development is an environmental catastrophe and an economic drain, and cancel all public sector support for these projects. Consider redirecting a portion of the savings into researching potential breakthrough energy technologies.
- Repeal CO2 emissions reporting requirements on large corporations. Under the new law, they are required to source this information from all their vendors including small businesses. It places a massive burden on all businesses for no purpose other than to produce reports. This information is not essential to formulating sound energy policy.
- End the regulatory push to eliminate natural gas hookups, abolish VMT penalties on home builders, and make solar roofs and other "renewable” features optional on new home construction. Assume as these technologies mature they will be adopted based on price and performance, instead of via mandates.
- Require the state legislature to review economic impact reports, environmental impact reports, and carbon life cycle analysis from multiple independent sources before mandating any new energy policy.

Conclusion

It is possible to have energy abundance in California, but unless current policies and strategies are changed, energy will remain overpriced, unreliable and environmentally destructive. Without fundamental changes Californians are increasingly vulnerable to supply disruptions. We are dangerously dependent on imports for every type of energy we consume including gas, oil, and virtually all forms of renewables hardware including batteries, wind turbines, and solar panels.

The alternative strategy we have described is a practical approach that cost-effectively fulfills the energy needs of Californians. It recognizes the potential of emerging alternative energy technologies including natural gas and nuclear, but stops short of mandating specific energy transitions. Our strategy instead leaves room for emerging clean technologies to establish their place in our energy landscape based on unsubsidized price and real world performance.

Our strategy rejects the official priority to achieve net zero as based on flawed assumptions in a variety of critical areas: scientific, economic, and political. In particular, the net zero objective denies Californians the ability to develop and adopt practical energy technologies that other states and nations will eagerly emulate.

For example, allowing all types of vehicles including advanced new hybrid vehicles on California roads after 2035 will permit innovators to develop cars that have effective MPGs well over 100, or hybrid cars that only use combustion when outside of dense urban areas, or cars that can easily be converted to run on alternative fuel, with those fuels competing for market share based on price. Continuing to permit vehicles that use liquid transportation fuel also allows us to retain our existing refueling stations, which can more easily be converted to accommodate new formulations for liquid fuels. This also takes pressure off the push to deploy fast-charge EV stations statewide, which in any case should be privately funded and consumer driven.

While we accept a voluntary transition to electricity whenever it becomes a practical and cost competitive energy choice of Californians, we believe it is only possible to generate enough of it if we rely on nuclear power along with a new fleet of highly efficient natural gas power plants. We support the goal of ensuring that electricity is available in sufficient abundance not only to power EVs and household appliances in a state where the population is growing again, but also new demands such as additional desalination capacity, possibly large-scale electrolysis of hydrogen, refining of synfuels...along with AI, cyber, robotics, and more. But in all cases we support these technologies not as mandates, but as innovations that earn their place in a competitive market.

Along with generating electricity from nuclear power and natural gas, we believe that photovoltaics have potential.

While we support utility scale photovoltaic power if it is sold in a competitive market as baseload electricity with storage included in the price, we also believe the state should develop a regulatory framework whereby private homes and businesses can purchase photovoltaics and sell their power on an equal basis with utility scale providers. This will decentralize ownership, production, distribution, and storage of electricity, reducing the load on the transmission grid.

To accommodate storage of intermittent solar energy we recommend the state develop standards and incentives to allow owners of EVs and hybrids to use their vehicle batteries to absorb surplus power from the grid and sell it back. In aggregate, EV and hybrid battery capacity is already on track to be many times what utility scale storage can offer. There should be a way to utilize this resource, benefitting vehicle owners and reducing the need for and cost of utility scale storage solutions.

We believe onshore wind should be discouraged in California. It is an environmentally problematic source of energy. We unequivocally call for plans for floating offshore wind to be canceled. It will devastate marine ecosystems and industrialize our coast. It has no place in an environmentally responsible energy strategy for our state.

Finally, we reject the abrupt abolition of oil production in California, for which the only certain effects will be economic hardship and increased oil imports, increasing carbon emissions.

California's current energy strategy is a path to poverty and micromanaged energy insecurity. It is reckless and unrealistic to reject or restrict practical solutions such as clean natural gas and nuclear power, or to destroy our in-state oil industry while tacitly acknowledging that the shortfall will just be made up with imports.

The strategy we recommend preserves options and encourages innovation. We don't know yet what breakthroughs are on the horizon, including synthetic fuels, advanced batteries, and fusion energy. We don't know what disruptions are coming, either. Diversifying our energy sources by including gas, oil, and nuclear, while retaining or expanding solar, biomass, and geothermal - and allowing all of them to compete based on price and performance, gives us the resilience to weather a shortage in any one of these.

Our positive, practical energy strategy will create a diverse, competitive energy landscape that rewards the innovative spirit that is inherently Californian. Our strategy will deliver energy abundance and affordability, while protecting our environment.

For the sake of all Californians, especially the millions of working families and countless businesses large and small for whom the cost of energy can be either crippling or enabling, we choose Energy Abundance.

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