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The Looming Rate Bomb

The 33 Percent Renewable Electricity Mandate and Electricity Prices in California

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Foreword: California Nudging Itself Over a Cliff

BY STEVEN F. HAYWARD, PH.D.

People who think the idea of central planning is dead haven't looked closely at California lately. California has always taken pride in being a "model for the nation" in everything from tax revolts to environmental policy. California appears ironically poised now to be a model for the nation on what not to do, though this possibility has escaped California's policy making class. The mandate-happy state has embraced prescriptive "smart growth" land use planning that requires high density mixed use development in place of what consumers in the marketplace might actually want. The state is singlehandedly attempting to solve global climate change by adopting the same kind of emissions trading scheme that Congress refused to enact and which is in retreat overseas. And the state is mandating the sources of electricity for California's once great economy—the subject of this analysis by Benjamin Zycher.

California policy makers don't regard any of these steps as partaking in central planning; they explain themselves in terms of engaging in a "nudge," the currently popular fallback position of authoritarians and planners everywhere.[1] "Nudgers" have convinced themselves that their market interventions and mandates make markets more efficient, or merely make beneficial decisions consumers would make for themselves if only they had as much information and enlightenment as the nudging class possesses. In some cases they may be right. Many workers might benefit from automatic enrollment in 401(k) retirement plans in their workplaces. The net utility of most nudges are more doubtful, however, from Mayor Michael Bloomberg's strictures on salt, trans-fat, and soft drinks, to the Obama Administration's mandate for high mileage automobiles. The line between a gentle "nudge" and harmful "shove" appears hard for policy makers to discern.

The illusion of mastery runs deep, which is why so many ostensibly smart people grasp superficial examples of the supposed success of planning. The Soviet Union enjoyed substantial economic growth for several decades (about 6 percent a year between 1928 and 1960), which seemed to validate economic planning, and led a number of prominent economists such as Paul Samuelson to predict back in the 1960s that Soviet national income would overtake the national income of the United States perhaps as soon as 1984. The 1980 edition of Samuelson's textbook moved the date back to 2002. The Soviet economy actually stopped growing perhaps as early as the 1960s, and certainly by the 1970s. Samuelson never noticed, nor did other liberal economists such as John Kenneth Galbraith, who well into the 1980s was praising the Soviet economy for making use of all its manpower and solving the problem of unemployment. Instead, as Daron Acemoglu and James A. Robinson explain in their recent book *Why Nations Fail: The Origins of Power, Prosperity, and Poverty*, the Soviet Union achieved a measure of real growth for a period through the simple expedient of forcibly moving low-output labor from agriculture to higher-output basic industries such as steel. Even an inefficient economy can reap large one-time gains by blunt force when it has a backwards economy to work with; even an acrophobic monkey can grasp the "low-hanging fruit," as the cliché goes. But, as Acemoglu and Robinson observe, "once all the inefficiently used resources had been allocated to industry, there were few economic gains to be had by fiat. Then the Soviet system hit a roadblock, with lack of innovation and poor economic incentives preventing further progress."[2]

Invoking the Soviet economy in a discussion of California's dirigisme energy policy will strike many readers a hyperbole or as a simple-minded straw man, unworthy of a place in a serious policy analysis. And yet we can observe the same kind of superficial confidence in the seeming effectiveness of energy mandates in California.

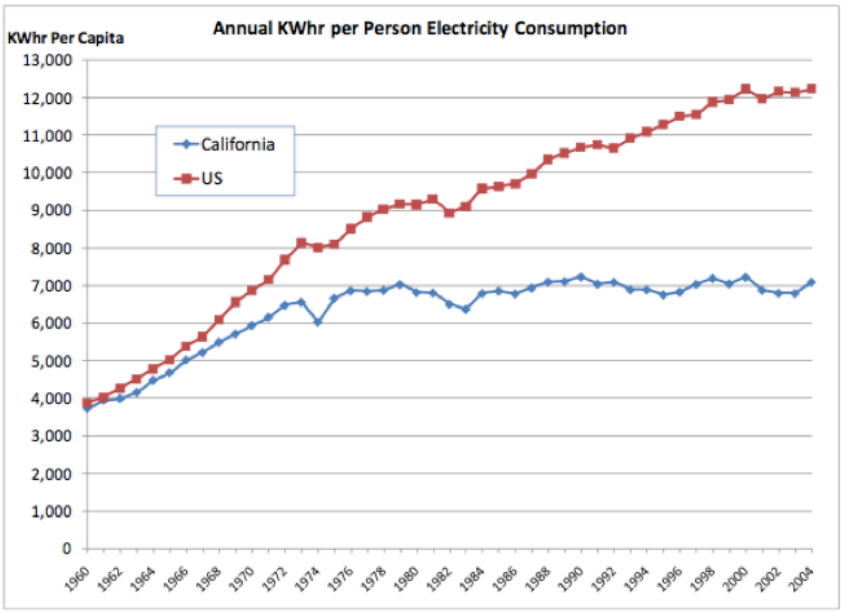
The new mandate to achieve one-third of California's electricity from renewable sources by the year 2020 is not a new venture for California's energy planners. California has been nudging the energy market since back in the 1970s,

1 The best articulation of "nudge" comes from Richard Thaler and Cass Sunstein's *Nudge: Improving Decisions about Health, Wealth, and Happiness* (New Haven: Yale University Press, 2008).

2 Daron Acemoglu and James A. Robinson, *Why Nations Fail: The Origins of Power, Prosperity and Poverty* (New York: Crown, 2012), p. 128.

and, like the Soviet economy in the mid-20th century, these efforts have been judged to be a great success. Starting in the mid-1970s, California embraced a "negawatt" strategy of encouraging energy conservation (typically called "demand-side management," or DSM) rather than siting new power sources, emphasizing more efficient appliance and building standards along with renewable energy from wind and solar power.

On the surface the result looks impressive: since 1970, while national per capital electricity consumption has risen by about one-third, per capita electricity consumption in California has remained flat. Today the average Californian uses 40 percent less electricity than the national average. Thus, even though California's household electricity rates are about one third higher than the national average (15 cents per Kwh in California versus 10 cents for the nation, according to the most recent Energy Information Administration figures[3]), California consumers don't have to spend appreciably more than citizens of other states. No harm, no foul. This supposed policy success even has a graphic depiction, known as the "Rosenfeld Curve" after long time California Energy Commission member Arthur Rosenfeld, who is a champion of energy efficiency policies, and shown in the figure below.



The Rosenfeld Curve: California and U.S. Per Capita Electricity Use

A great policy success? If all you had to go on was this simple chart, you might well reach that conclusion. And this chart is frequently the main exhibit that renewable energy and conservation advocates rely on to make their case.

The real world of energy use in California is not as simple as this famous figure makes out. Because the subject is complex and there are gaps in the data, there have been few careful studies made evaluating demand side management of energy use in California. The California Energy Commission last studied the issue in 1995, with a study that was surprisingly vague and tentative about the effect of demand-side management policies, noting that structural and climactic differences between California and the rest of the nation explain a large portion of the differences observed in California.[4] For example:

> It *appears* that policies such as building codes, appliance standards, and utility DSM programs helped to reduce residential energy use. California residences consume less energy than typical U.S residences,

3 U.S. Energy Information Administration, Form EIA-826, *Monthly Electric Sales and Revenue Report with State Distributions Report* (September 2012, accessed November 27, 2012).

4 Lee Schipper and James E. McMahon. "Energy efficiency in California: A historical analysis." Report to California Energy Commission ERCDC A.24 S336a 1995, American Council for an Energy-Efficient Economy, 1995. http://aceee.org/research-report/e951.

> due in large part to structural factors such as less floor area per household, greater reliance on natural gas, and the significantly milder heating season compared to the national average. (Emphasis added.)

The 1995 study concluded that about two-thirds of the difference in energy use between California and the national average was attributable to structural (that is, different forms of economic activity) and climate differences, and that "it is difficult to determine what caused these trends," but that "it *appears* that both energy prices and state policies played a role." (Emphasis added again, to show how the study strains to reach the conclusion it assumes to be correct.)

A 2010 paper produced by U.C. Berkeley graduate student Howard Chong for the United States Association for Energy Economics examined the effect of recent California building codes that mandate higher energy efficiency in new residential structures, and found that the building standards not only failed to achieve their object, but may have led to *increased* overall energy consumption among some new households. Chong concluded:

> It is not safe to conclude from this paper that building codes in California have failed, but it should temper declarations that they are a success and especially temper the interpretation of the Rosenfeld Curve for California as "evidence" that California energy efficiency policies are the cause of California's impressive energy efficiency performance.[5]

The most thorough study of California's energy trends is found in a 2011 doctoral dissertation from Anant Sudarshan of Stanford University's Precourt Institute for Energy Efficiency. Sudarshan takes up the Rosenfeld Curve and similarly concludes that California's deliberate policies to promote efficiency only explain about 20 percent of the difference between California's per capita consumption and the national level; the majority of the difference is explained by structural factors (including one aspect most analysts overlook: demographic factors).[6] Even Sudarshan's highly technical and carefully qualified academic language cannot hide the evidence that, as Sudershan finds, "state programs are not the primary determinant of California's low energy intensities," and he issues caution that "A large number of people are interested in efficiency evaluation and performance comparisons and unfortunately it is human nature to take limited evidence and attempt to stretch it to find some answers."[7] Sudarshan concludes:

> In particular, we need to be careful when we identify seemingly spectacular success stories screened on the basis of a single aggregate statistic. . . California looks different from the rest of the nation because it is different—in ways that have little to do with energy policy. Thus replicating the California experience will not be easy elsewhere.[8]

In other words, in exchange for electricity prices one-third higher than the national average, California has had only modest real gains in energy efficiency from its deliberate policies. (And Sudershan reminds us that "The average prices of electricity in California are not a result purely of market forces.")

It is against this background that California's next proposed great leap forward—the mandate to generate one-third of its energy from non-hydro renewable sources by the year 2020—should be seen. This target is up from about 12 percent in 2010, which, it should be noted, fell short of California's *existing* renewable energy mandate for that year. As Benjamin Zycher explains in copious detail here, achieving this goal will be extremely expensive, and will impose significantly higher costs on ratepayers. As the prohibitive cost becomes more apparent, Califor-

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5 http://www.iaee.org/en/students/best_papers/Chong.pdf, p. 21.

6 Sudarshan, Anant. *Deconstructing the Rosenfeld Curve: Structural Determinants of Energy Consumption.* Stanford University, 2011 (available at http://books.google.com/books?hl=en&lr=&id=79l601BxXzAC&oi). Several earlier versions of the Sudarshan study have been produced. See http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1715860##;

7 Sudarshan, pp. 63, 67.

8 Sudarshan, pp.149, 150.

nia regulators may be tempted to attain the renewable energy goal through the back door of imposing more stringent conservation standards, even though most of the low-hanging fruit of reduced energy intensity has already been harvested. (California can only shut down its aerospace industry once, for example.) One way to reach the 33 percent renewable standard if not enough windmills and solar panels can be built is to reduce overall electricity use and shut down conventional generation sources.

Meanwhile, the state's own Little Hoover Commission (the colloquial name for the Commission on California State Government Organization and Economy) issued a report late last year warning that the success of California's ambitious energy directives is "complicated by a balkanized energy governance structure" that "no one would have designed on purpose."[9] Moreover, the report is "concerned" that that cost of California's energy ambitions is hard to estimate, but but is likely to be substantial. That may not be the most serious problem, though:

> The lack of an overall cost estimate points up a more profound concern. Despite assembling an ambitious agenda that has gained the world's attention, the state has failed to develop a comprehensive, energy strategy with clearly delineated priorities to ensure that policies are not working at cross-purposes and that California achieves its environmental stewardship goals.
>
> Policies and regulations affecting electricity have been piled upon each other piecemeal. As a result, numerous state bodies are implementing a long and complicated list of new directives through multiple, sometimes overlapping public processes. In this report, the Commission calls for a timeout.

The idea of what the Commission calls a "timeout" would once have been understood by a simpler name: reform. Yet California thermocrats say there is no time for reform, and that despite the chaotic structure of California's energy policy they've got things in hand because they're able to . . . have more meetings. As the Commission states in its neutral prose: "[G]overnment players are cooperating and collaborating as never before, in part due to strong personal connections forged over decades."

This appalling waste of manpower resources is the antithesis of the rule of law; good policy should never depend on "strong personal connections" of public servants. It also presumes that the private sector is equally able to waste countless new person-hours in meetings to "coordinate" layers and layers of barnacled and often conflicting regulatory policy and mandates. And so a state that once prided itself on being a leading practicioner of reform is coming ever more to resemble the sclerotic and unreformable economies that we once scoffed at in Eastern Europe.

Meanwhile, California continues to neglect the economic potential of its own hydrocarbon resources. While North Dakota is running budget surpluses and enjoys unemployment at the vanishingly small rate of about 2 percent because of the boom in developing the Bakken shale oil fields, one recent estimate concludes that California's oil shale resources are potentially four times larger than the Bakken.[10] By some estimates California could exceed Texas as the nation's leading oil producing state, and might generate as much as $250 billion in tax revenue, and $1 trillion in total economic activity, over the next two decades if it allowed increased oil and gas production inside the state's borders.[11] The International Energy Agency recently wrote: "The idea that fossil fuels will fade from thea scene seems more preposterous every day. Instead of getting left behind in this new era, the Golden State could—and should—lead the way."

For once, California ought to listen to the rest of the world, instead of insisting on being a model for a dead end direction.

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9 "Rewiring California: Integrating Agendas for Energy Reform," Little Hoover Commission, December 2012, http://www.lhc.ca.gov/studies/214/Report214.html.

10 http://oilprice.com/Latest-Energy-News/World-News/Californias-Shale-Formation-is-Four-Times-as-Large-as-the-Bakken.html.

11 Mark Mills, "California Could Be the Next Shale Boom State," *Wall Street Journal,* January 16, 2013; http://online.wsj.com/article/SB10001424127887323353204578128733463180210.html.

Summary

The state of California has mandated that by 2020, 33 percent of its electricity supplies be obtained from such nonhydroelectric "renewable" sources as wind, solar, and geothermal technologies. Current estimates of the cost of this requirement are too low by a substantial amount, largely because of underestimated costs for transmission, backup capacity, and generation. This paper provides a far more realistic estimate of the cost of the California renewables requirement.

The mere fact that such a "renewable portfolio standard" must be mandated legally suggests strongly that nonhydroelectric renewable electricity is uneconomic, that is, it is more costly than electricity generated with conventional technologies. Accordingly, the requirement will impose substantial unnecessary costs upon the electric power sector and the California economy writ large. The small market shares of renewable power technologies across the nation reinforce that inference of relatively high costs, as do the various cost analyses available from the Energy Information Administration, which show that the costs of renewables are far higher than those of such conventional power technologies as natural gas generation.

Even those EIA estimates of the cost disadvantages of renewable power are too conservative. The EIA projections of the higher transmission costs of renewable power are too low in the California context, and the EIA analyses do not account for the substantially higher backup and generation costs attendant upon an expanded market share for renewable electricity. The California 33 percent RPS will impose upon the state in 2020 an aggregate marginal economic cost of about $5 billion in year 2011 dollars. Table S1 summarizes this finding.

Table S1

Marginal Cost of the California 33 Percent RPS in 2020
(millions of year 2011 dollars)

Transmission	941.6
Backup	550.0
Generation	3500.0
Total	4991.6

That $5 billion cost of the RPS requirement in 2020 is an implicit tax of 27 percent relative to the generation and transmission costs of projected consumption in 2020 were it to be produced with the electric generation technology mix of 2012. Moreover, this implicit tax to be imposed upon the California economy will grow each year as the size of the electricity market expands and the RPS requirement forces ever-greater amounts of high-cost power onto the market. Over the longer term, this cost effect will increase proportionately with power consumption unless there is a decline in the relative cost of renewable power, a prospect for which there is little evidence in the cost trends, and which is highly dubious given current and prospective prices for natural gas.

This perverse effect inexorably will be reflected fully in rising rates paid by consumers, whether directly or indirectly. Rates and other costs borne by consumers, taxpayers, businesses, and other parties—ultimate consumer costs—must cover the marginal cost of the RPS mandates, even if those costs are hidden in part with various subsidies and other policy tools. Consumer costs in 2020 will rise by over 13 percent—in real terms, that is, after adjusting for inflation—as a result of the 33 percent RPS requirement.

Note that California power rates are very likely to rise by almost 20 percent even in the absence of the costs imposed by the 33 percent RPS requirement, due to the prospective need for various capital investments driven by both economic and regulatory factors, and by the California cap-and-trade program mandated by the 2006 Global Warming Solutions Act. Accordingly, the extra costs to be imposed by the 33 percent RPS requirement will exacerbate those cost increases that largely are independent of the RPS requirement itself. Californians between now and 2020 will be confronted with an overall increase in power prices and costs of approximately 33 percent. Table S2 summarizes these effects.

Table S2

Components of Prospective Rate Increases for California

Source	Rate Increase (percent)
Capital Investment: economic, regulatory	16.7
33 Percent RPS Mandate	13
Cap-and-Trade Costs	3
Total	32.7

Table S3 summarizes current average electricity rates for all sectors (industrial, commercial, and residential) in California and in various other regions of the U.S., and thus the competitive disadvantage that the 33 percent RPS mandate will exacerbate.

Table S3

Average End-Use Retail Electricity Rates, September 2012

Region	Dollars per Megawatt-Hour
California	157.70
Oregon	81.80
Washington	68.20
Mountain	92.90
New England	142.10
Middle Atlantic	134.10
East North Central	93.50
West North Central	88.90
South Atlantic	99.50
East South Central	89.00
West South Central	84.40
U.S. Total	103.10

For all sectors, California retail rates are 93–131 percent higher than those in the Pacific Northwest, and 70 percent higher than those in the Mountain region. They are 53 percent higher than those for the U.S. as a whole, a figure biased downward by high costs for Alaska and Hawaii and by the inclusion of California rates in the average figure for the U.S. Rates in other states and regions may rise as 2020 approaches, but the 33 percent RPS requirement in California is very likely to increase rather than reduce the state's relative price disadvantage. This adverse effect is certain to worsen the other important disadvantages that various California public policies have created in terms of competitive dynamics with other states.

The arguments usually offered in support of RPS requirements, while not the focus of the discussion here, are far weaker than commonly assumed. This means that the higher costs to be borne by the California economy will not be offset even in part by economic benefits. That these rising costs to be imposed upon the private sector might engender greater political opposition to the RPS requirements may be a source of hope for policy reform.

I. Introduction

On April 12, 2011, California Governor Jerry Brown signed legislation requiring that by 2020 California electric utilities obtain 33 percent of their power supplies from such renewable sources as wind farms and solar facilities.[1] A number of rationales have been offered in support of this mandate—in part, it is a natural offshoot of the California Global Warming Solutions Act of 2006 ("AB32")—but the cost of actually implementing this 33 percent "renewable portfolio standard" (RPS) is a topic characterized by a wide range of assertions sometimes supported by analyses equally variable in terms of their rigor.

Unsurprisingly, therefore, considerable disagreement prevails. But there are good reasons to believe that retail electricity prices in California will rise sharply as a result of the renewables mandate; after all, the small market shares of renewable power technologies—wind and solar power in particular—suggest that they are not generally competitive in terms of relative cost. The Chairman of the California Public Utilities Commission (CPUC), Mr. Michael Peevey, addressed this issue last August in testimony before the state Senate Energy Committee; an industry newsletter reports that

> With regard to achieving the mandated RPS target, Peevey testified that… the price of these resources will increase rates significantly starting around 2015 when a 'plethora of contracts begin delivering.' Peevey used [the expression] … 'rate bomb' to describe the future impact on electricity consumers. Peevey added, 'There are consequences of some of these environmental policies.'[2]

Electricity can be generated using several alternative energy sources, among them such conventional power technologies as coal and natural gas plants, nuclear generating stations, and hydroelectric facilities. "Renewable" sources of electric power—wind, solar, geothermal, and other such unconventional technologies—increasingly are asserted by many as the electricity sources that will come to dominate the market in the years ahead, because of purported advantages in terms of resource depletion, effluents and other environmental impacts, "green" employment, and other rationales.[3]

There are good reasons to believe that retail electricity prices in California will rise sharply as a result of the renewables mandate.

For the most part, historical investment choices among alternative generation types have been driven by considerations of capital, operating, and transmission/distribution costs, siting considerations, and other such factors that loosely can be summarized as calculations of relative overall cost. This operational criterion of relative cost has been partially distorted by the incentives of regulators—public utility commissions at the state level and the Federal Energy Regulatory Commission at the federal level—to use electricity rates to sub-

1 See http://leginfo.ca.gov/pub/11-12/bill/sen/sb_0001-0050/sbx1_2_bill_20110412_chaptered.pdf. Renewable generating facilities must be located within the Western Electricity Coordinating Council (essentially, the fourteen western states plus Alberta and British Columbia), using some combination of wind, sunlight, geothermal resources, biomass, biogas, fuel cells, hydroelectric facilities smaller than 30 MW, municipal solid waste, and wave/tidal energy.

2 Foothill Services Nevada, *The Burrito,* Vol. XV, No. 26 (August 17, 2012), at 6.

3 There is no accepted definition of "renewability" in the context of electric power technologies, or, for that matter, generally. Renewability presumably refers to an assumption that the underlying energy source is not depletable, which is both irrelevant analytically and incorrect in any event, since the production of power from renewable sources requires the use of other resources that are not "renewable." Moreover, any given renewable energy resource, even if not depletable, provides actual energy that is finite. See Benjamin Zycher, *Renewable Electricity Generation: Economic Analysis and Outlook,* Washington D.C.: The AEI Press, 2011, pp. 32-54.

sidize particular groups of consumers, whether directly or indirectly. But the long-term competition among states to attract investment and business location decisions, to increase employment, and to expand the tax base imposes real constraints upon the ability of regulators to violate the relative cost criterion when making regulatory decisions about proposed generation investments.[4] Table 1 presents a summary of recent cost estimates from the U.S. Energy Information Administration for alternative generation technologies.

Table 1

Average Levelized Costs for Plants Entering Service in 2017

(year 2011 dollars per mWh)

Plant Type	Capital and other Fixed	Variable	Transmission	Total
Gas combined cycle	19.5	46.8	1.2	67.5
Hydroelectric	82.6	6.1	2.1	90.8
Wind	94.3	0.0	3.9	98.0
Conventional coal	70.4	28.1	1.2	99.8
Geothermal	88.8	9.8	1.6	100.2
Nuclear	100.9	11.8	1.1	113.8
Solar thermal	240.7	0.0	6.4	247.2

Source: U.S. Energy Information Administration, "Levelized Cost of New Generation Resources in the Annual Energy Outlook 2012," July 2012, at http://www.eia.gov/forecasts/aeo/pdf/electricity_generation.pdf, at Table 1; Bureau of Economic Analysis at http://www.bea.gov/iTable/index_nipa.cfm; and author computations.
mWh: megawatt-hour.
Note: Totals may not sum due to rounding. Cost estimates exclude the effects of various subsidies.

For reasons discussed below, the EIA estimates of total costs shown in Table 1 for wind, solar thermal, and geothermal power are very likely to be biased downward significantly.[5] More broadly, the EIA cost estimates are consistent with the observation that nonhydroelectric renewable power has never proven itself in the absence of large subsidies to be competitive with conventional generation except in some narrow applications, and the EIA estimates summarized in Table 1 project a continuing competitive disadvantage relative to gas-fired generation at a minimum. That is the central reason that such unconventional power represented 2.2 percent of the U.S. market in 2005, rising only to about 4.0 percent in 2011 despite large subsidies and other forms of policy support at the state and federal levels.[6] One such type of policy support is the RPS, essentially a mandated market share for renewable power in a given state over some defined time horizon. Among the thirty states (and the District of Columbia) that have enacted such RPS requirements, California has adopted the most stringent requirement, for a 33 percent market share by 2020, as noted above.[7]

4 See Benjamin Zycher, "Keeping the Power On," *Regulation*, Vol. 23, No. 4 (Winter 2000), at http://www.cato.org/pubs/regulation/regv23n4/zycher.pdf.

5 In the Energy Information Administration analysis for 2020, wind generating capacity in California is projected at 57 percent of total nonhydroelectric renewable capacity. See Energy Information Administration, *Annual Energy Outlook 2012,* at http://www.eia.gov/forecasts/aeo/sector_electric_power.cfm, at Table 58.2.

6 For the generation/market share data see EIA, *op. cit.*, fn. 5 *supra.*, at Tables 55 and 58. For a discussion of the policy support, see Zycher, *op. cit.* fn. 3 *supra.*, at 8-18.

7 Seven other states have adopted RPS goals not yet mandatory.

II. The California Renewable Portfolio Standard

The original California RPS was enacted in 2002 and required all sellers of power into the retail market to obtain 20 percent of their supplies from renewable resources by 2017. In 2006, that deadline was moved forward to 2010, with required annual increases of at least 1 percentage point between 2006 and 2010.[8] In addition, executive orders issued by Governor Arnold Schwarzenegger in 2008 and 2009 established a further RPS goal of 33 percent by 2020, directing the California Air Resources Board (CARB) to adopt regulations to achieve that end.[9] The legislation signed by Governor Jerry Brown in April 2011 elevated the 33 percent RPS mandate into a legal requirement by 2020, with intermediate requirements of 20 percent between 2011 and 2013, and 25 percent by 2016.[10]

Table 2 presents data and projections from the EIA on total and nonhydroelectric renewable generation for California for 2009 through 2025.

Table 2

California Electric Generation 2009-2025
(millions of mWh)

Year	Total	Non-Hydro Renewable	Non-Hydro Renewable/Total (percent)
2009	194.9	20.5	10.5
2010	192.8	21.5	11.1
2011	196.2	23.1	11.8
2012	204.4	25.0	12.2
2013	203.3	35.6	17.5
2014	206.2	36.4	17.7
2015	209.1	36.4	17.4
2016	211.0	36.5	17.3
2017	213.3	37.9	17.8
2018	217.6	40.3	18.5
2019	222.5	41.3	18.6
2020	213.1	43.1	20.2
2021	214.9	44.5	20.7
2022	217.3	46.6	21.4
2023	221.8	50.7	22.9
2024	227.5	52.3	23.0
2025	234.1	53.5	22.9

Source: Energy Information Administration, *op. cit.*, fn. 5 *supra.*, at Tables 55.2 and 58.2; and author computations.
mWh: megawatt-hours.

8 See California Senate bill 1078, chapter 516, enacted September 12, 2002, at http://energy.ca.gov/portfolio/documents/SB1078.PDF; California Senate bill 107, chapter 464, enacted September 26, 2006, at http://energy.ca.gov/portfolio/documents/sb_107_bill_20060926_chaptered.pdf; and California Senate bill 1036, chapter 685, enacted October 14, 2007, at http://energy.ca.gov/portfolio/documents/sb_1036_bill_20071014_chaptered.pdf.

9 See Executive Order S-14-08, November 17, 2008, at http://www.gov.ca.gov/executive-order/11072/; and Executive Order S-21-09, September 15, 2009, at http://gov.ca.gov/executive-order/13269.

10 See fn. 1 *supra.*

The EIA projections suggest that achievement of the California 33 percent RPS by 2020 may prove difficult. The EIA reports total California generating capacity in 2012 at 69,880 megawatts (MW), of which 9650 MW are from nonhydroelectric renewable technologies.[11] That renewable capacity proportion is about 13.8 percent. EIA reports also that gross power imports into California from elsewhere in the WECC were about 59.8 million mWh.[12] If we assume—very generously—that 25 percent of that imported power was generated by nonhydroelectric renewable facilities, then from Table 2 above total renewable consumption in the state in 2012 (40 million mWh, ignoring in-state transmission losses and other such minor complexities) would have been about 16 percent of total consumption, estimated by the EIA at 251.4 million mWh. Note that the determination of the amount of "renewable" power imported into a given state is a calculation that suffers from a substantial definitional problem, in that assumptions about which generating plants produced the particular electrons that traveled over interstate transmission lines essentially are arbitrary.

A renewables sales proportion of 22 percent in 2020—is very likely to be biased upward.

For 2020, EIA projects total California generating capacity at about 72,280 MW, of which 11,200 MW are assumed to be nonhydroelectric renewable technologies. That renewable capacity proportion is about 15.5 percent. From Table 2, the projected renewables proportion of in-state generation is greater, at 20.2 percent. The EIA projection of gross power imports into the state from the rest of the WECC is about 64.8 million mWh. If we assume—again, very generously—that 25 percent of that power will be produced by nonhydroelectric renewable facilities, then total renewable consumption would be 59.3 million mWh, or 22 percent of total sales of 267.4 million mWh, again as projected by the EIA.

Even that estimate—a renewables sales proportion of 22 percent in 2020—is very likely to be biased upward. A renewables generation/sales proportion (22 percent) greater than the renewables capacity proportion (15.5 percent) almost certainly will not be observed because capacity factors—essentially, the proportion of the year during which renewable facilities actually can generate power—are substantially lower for wind and solar facilities than is the case for most conventional generation, and the intermittent nature of wind flows and sunlight exacerbates this problem.[13] The renewables share of capacity is virtually certain to exceed the renewables share of actual generation.

11 See EIA, *op. cit.*, fn. 5 *supra.*, at Tables 55.2 and 58.2; and author computations.

12 As noted in fn. 1 *supra.*, the California RPS requirements may be met with power imported from elsewhere in the WECC. See EIA, *Annual Energy Outlook 2012,* Table 92, at http://www.eia.gov/forecasts/aeo/tables_ref.cfm.

13 The EIA estimates of capacity factors for conventional coal, gas, and nuclear plants are, respectively, 85 percent, 87 percent, and 90 percent. For wind and solar thermal capacity they are 33 percent and 20 percent, respectively, and 53 percent for hydroelectric plants. See EIA, *op. cit.*, Table 1 *supra.*, at Table 1.

III. The California RPS: Some Cost and Rate Calculations

At a minimum, these data and projections—and the actual observed small market share of renewable power—suggest strongly that renewable power is relatively costly, and that enforcement of a 33 percent RPS in California by 2020 has the potential to impose substantial extra costs upon power consumers in the state, and by implication, upon the state economy writ large. One component of this cost problem is the reality of low capacity factors characteristic of renewable power, as noted above. Since various federal subsidy programs—an example is the production tax credit enjoyed by producers of wind power—allow a given state to shift part of its RPS costs onto federal taxpayers generally, the effects of low capacity factors and subsidies to some degree offset each other in the context of a given state; that calculation is outside the scope of the analysis here. More broadly, subsidies of various kinds, whether explicit or implicit, do not reduce true economic costs; instead they hide and/or shift them, and economic analysis should not treat those effects as cost "reductions," particularly given that California taxpayers are forced to subsidize the RPS requirements imposed by other states even as taxpayers outside California are forced to do the same in terms of the California RPS.

These higher generation costs that characterize renewable power are discussed below. Two factors in addition to higher generation costs also are relevant, and seem not to have been examined in sufficient detail in the available literature on the California RPS: the higher cost of transmission for wind, solar thermal, and geothermal power, and the cost of backup capacity for wind and solar thermal generation.

Transmission Costs. Conventional generating plants can be sited virtually anywhere, with fuels transported to the plants. This means that transmission costs and other factors and tradeoffs can be optimized more easily than is the case for wind farms (and solar thermal and geothermal sites), which obviously must be sited where the wind blows with sufficient intensity and reliability. Accordingly, it would be surprising if transmission costs were not higher for these forms of renewable power.

From Table 1 above, the EIA estimates of transmission costs for these renewables are substantially higher than those for gas, coal, or nuclear power. For wind generation—$3.90 per mWh—it is over three times higher. Moreover, there are good reasons to believe that the EIA estimates are markedly lower than those that California is likely to experience under the 33 percent RPS. This is true in part because the EIA estimate includes transmission costs for wind power generated and delivered in the U.S. "wind corridor" extending from the northern plains down through Texas. The California Public Utilities Commission in 2009 published an analysis concluding that implementation of a 20 percent RPS requirement for the state by 2020 would require four new major transmission lines at a cost of about $4 billion, while a 33 percent RPS standard would require seven new lines at a cost of $12 billion.[14]

Calculations provided in the CPUC report suggest that the analysis is problematic. The CPUC projections imply about 310 million mWh of total California electricity consumption in 2020; current consumption (in 2012)

14 See California Public Utilities Commission, "33% Renewables Portfolio Standard Implementation Analysis," June 2009, at http://www.cpuc.ca.gov/NR/rdonlyres/1865C207-FEB5-43CF-99EB-A212B78467F6/0/33PercentRPSImplementationAnalysisInterimReport.pdf, at p. 1 and Table 5.

is about 251 million mWh.[15] That future consumption level in the CPUC analysis is virtually unaffected by price (or average cost), an outcome that calls the overall analysis into question. Another projection in the study that raises concerns is the conclusion that an all-gas power production scenario in 2020 yields an average price only slightly lower than that forecast for the 20 percent RPS reference case ($154 per mWh versus $158 per mWh); and the average price in the 33 percent RPS reference case is only $11 higher, at $169 per mWh. Those differentials are not plausible unless they exclude important costs or subsidy effects. In any event, let us take the CPUC $12 billion figure as given. If we assume 33 percent of that total consumption in 2020 (310 million MWh) is from renewables, a 50-year life for the associated transmission lines, and a 5 percent real rate of interest, we have 102.3 million mWh of renewable power imposing an annual transmission cost of about $654 million, ignoring line losses, maintenance costs, and other such minor factors. That works out to about $6.39 per mWh for transmission costs, about 64 percent higher than the EIA estimate of $3.90 noted above.[16]

> Subsidies of various kinds, whether explicit or implicit, do not reduce true economic costs; instead they hide and/or shift them, and economic analysis should not treat those effects as cost "reductions,"

Even that figure is less than half of the finding from a survey of 40 transmission studies conducted during 2001-2008.[17] Mills *et. al.* find a median transmission cost of $15 per mWh.[18] The survey was limited to studies of transmission requirements for multiple new wind plants with a combined capacity greater than 300 MW, a subset of projects relevant to achievement of the California RPS. If we assume, conservatively, that transmission costs for the renewable power delivered to satisfy the 33 percent RPS are at the average of the CPUC calculations and the Mills survey, the resulting cost figure is about $10.70 per mWh, a figure far higher than those usually discussed in the literature promoting the California RPS. These projections for transmission costs are consistent with the hypothesis that wind and solar power are constrained in terms of available sites, and so impose higher marginal transmission costs than is the case for conventional generation.

The Cost of Backup Capacity. Electric energy in large amounts cannot be stored at low cost in batteries due to technological limitations; only indirect storage in the form of water in dams is economic. This reality means that

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15 Imported power accounts for most of the difference between generation and consumption.

16 Note that it is not clear whether the 20 percent or 33 percent RPS standard applies to capacity, generation, contracted power, or some other parameter. Michaels has a useful discussion of the ways in which RPS compliance has been defined downward as achievement of RPS mandates has proven elusive. See Robert J. Michaels, "A Federal Renewable Electricity Requirement: What's Not to Like?", Cato Institute Policy Analysis No. 627, November 13, 2008, at http://www.cato.org/pub_display.php?pub_id=9768, at 12. Note also that because of the recent economic downturn and projected economic conditions in California, the transmission requirements and costs for 2020 reported in the 2009 CPUC report may be higher than would be the case were the analysis to be updated. The current EIA projection for consumption in 2020 is about 267.4 million mWh; see EIA, *op. cit.*, fn. 5 *supra.*, at Table 55.2. See also http://docs.cpuc.ca.gov/efile/RULC/127544.pdf and http://www.cpuc.ca.gov/PUC/energy/procurement/LTPP/ltpp_history.htm. The Federal Energy Regulatory Commission, in a recent case involving the Midwest Independent Transmission Operator, ruled that the transmission costs attributable to wind generation may be allocated to consumers regardless of the amount of wind power actually consumed by any given ratepayer. This ruling essentially spreads such costs across the entire grid; accordingly, the transmission costs associated with renewable generation are not reduced but instead are hidden somewhat from calculations of the marginal cost of renewable power. See the FERC Conditional Order, Docket No. ER10-1791-000, December 16, 2010, at http://www.ferc.gov/whats-new/comm-meet/2010/121610/E-1.pdf.

17 See Andrew Mills, Ryan Wiser, and Kevin Porter, "The Cost of Transmission for Wind Energy: A Review of Transmission Planning Studies," Lawrence Berkeley National Laboratory, LBNL-1471E, February 2009, at http://eetd.lbl.gov/EA/EMP/reports/lbnl-1471e.pdf, at 6-8.

18 The cost figures are reported in nominal dollars (that is, unadjusted for inflation). Accordingly, the cost figures in year 2011 dollars would be somewhat higher.

the production and consumption of electricity in a given power network must be balanced constantly in order to prevent blackouts, and more generally to preserve system reliability. Because unexpected surges in demand and/or outages of generating equipment can occur, backup generation capacity must be maintained; such backup capacity is termed the "operating reserve" for the given network. This operating reserve is of two types; the first is the "spinning reserve," that is, generators already connected to the network, the output of which can be increased by raising the torque applied to the generating turbines. The typical system requirement is that spinning reserves be 50 percent or more of total operating reserves. The second component of operating reserves is the supplemental reserve, which comprises generation capacity that can be brought on line within five to ten minutes and/or electric power that can be obtained quickly from other networks or by withholding power being distributed to other networks. Additional reserve capacity often is provided by generators that require up to an hour to come on line; this backup capacity is not included in measures of the operating reserve for a system because of the length of time required for availability.

Electric supply systems respond to growing demands ("load") over the course of a day (or year) by increasing output from the lowest-cost generating units first, and then calling upon successively more-expensive units as electric loads grow toward the daily (or seasonal) peak. Most electric generation capacity fueled by renewable energy sources is not "dispatchable," that is, it is not available upon demand. In other words, system planning and optimization cannot be based upon an assumption that it will be available to provide power to the grid when it is expected to be most economic, for the simple reason that wind flows (and sunlight) cannot be predicted far in advance. Accordingly, renewable capacity cannot be scheduled: It requires backup generation capacity to preserve system reliability.[19]

A recent study of the operational impacts of increasing RPS mandates for the California electricity system noted that "the variability and high-ramping characteristics of renewable generation create operational issues."[20] Without backup generation and/or power storage, one conclusion in that study is that "system performance degraded, in terms of maximum area control error excursions and North American Electric Reliability Corporation control performance standards, significantly for 20 percent renewables penetration and became extreme *(sic)* at 33 percent renewables penetration, using the same automatic generation control strategies and amounts of regulation services as today."[21]

> Expansion of renewable power generation requires ancillary investment in backup capacity using conventional (dispatchable) technologies.

The study, using figures from the California Independent System Operator, projects that the increase in renewable generation capacity between 2009 and 2020 would be about 17,700 MW for the 20 percent RPS, and about 22,400 MW in the 33 percent case.[22] The projected needs for backup capacity (of varying types) are, respectively, 800 MW (in 2012) and 4800 MW (in 2020).[23] For the 20 percent RPS in 2012, that backup requirement is 4.5 percent (800/17,700); for the

19 See, e.g., EIA, "Impacts of a 15-Percent Renewable Portfolio Standard," Report #: SR-OIAF/2007-03, June 2007, at http://www.eia.gov/oiaf/servicerpt/prps/rps.html.

20 KEMA, Inc., "Research Evaluation of Wind Generation, Solar Generation, and Storage Impact on the California Grid," June 2010 at http://www.energy.ca.gov/2010publications/CEC-500-2010-010/CEC-500-2010-010.PDF, at 1.

21 *Ibid.*, at 2-3.

22 This includes photovoltaic, solar thermal, and wind generation. The 2009 figure cited is 3800 MW, and the respective low and high (20 percent and 33 percent RPS) figures for 2020 are about 21,500 MW and 26,200 MW. See *Ibid.*, at 28 (Table 3).

23 See *Ibid.* at 3-4.

33 percent RPS in 2020, the projection (21 percent) is about the same as that reported by Kreutzer *et. al.* (citing a study by the National Renewable Energy Laboratory), of a need for 0.2 MW of backup capacity for each MW of wind capacity.[24]

In short: Expansion of renewable power generation requires ancillary investment in backup capacity using conventional (dispatchable) technologies. This is the case in particular for wind and solar thermal generation; for those, the EIA projection is for about 7400 MW of capacity by 2020. This would require about 1500 MW of conventional backup capacity. What would that cost?

> Since the 33 percent RPS requirement will force the nonhydroelectric renewable market share upward, and the conventional (predominantly gas-fired generation) market share downward, it will substitute higher-cost power in place of lower-cost power.

Let us assume, reasonably, that in the California context all of this backup capacity is combined-cycle gas (CCG) technology. From Table 1 above, fixed and variable costs per mWh for CCG generation sum to about $66 per mWh. If we assume, reasonably, a capacity factor for the backup units of 40 percent, backup generation would be about 5.3 million mWh per year, for a total of about $350 million annually. The EIA projection of wind and solar thermal generation in California in 2020 is about 20 million mWh; as discussed below, this EIA projection is not consistent with the 33 percent RPS requirement. A more conservative estimate for wind and solar thermal generation in 2020 is 28 million mWh under a 33 percent RPS.[25] Accordingly, the backup cost per mWh of this wind and solar power would be about $12.50 (= $350 million/28 million mWh).[26] This would be in addition to the $10.70 per mWh of additional transmission costs discussed above.

Increased Generation Costs. From Table 1 above, total generation cost per mWh (excluding transmission) for wind power is about $94; the comparable figure for solar thermal generation is $241.[27] The EIA projects as well substantial geothermal capacity and generation in 2020 as a component of the California electricity mix. Again from Table 1, the total generation cost per mWh for geothermal power (excluding transmission) is about $98.60. Given the EIA projections of 2020 generation by wind, solar thermal, and geothermal facilities of, respectively, 17.6 million mWh, 2.2 million mWh, and 17.7 mWh, the weighted average generation cost for these three renewable sources is about $104.80 per mWh.[28]

From Table 1 above and from the EIA projection of the generation mix for California in 2020, the weighted average generation cost (excluding transmission) for power other than wind, solar thermal, and geothermal is about $65 per mWh (in year 2011 dollars).[29] The EIA projects that wind, solar thermal, and geothermal technologies

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24 See David W. Kreutzer, et. al., "A Renewable Electricity Standard: What It Will Really Cost Americans," Heritage Center for Data Analysis, Report CDA10-03, May 5, 2010, at 5, at http://heritage.org/Research/Reports/2010/05/A-Renewable-Electricity-Standard-What-It-Will-Really-Cost-Americans.

25 See California Public Utilities Commission, *op. cit.*, fn. 14 *supra.*, at Figure 1.

26 See EIA, *op. cit.*, fn. 5 *supra.*, at Table 58.2; and fn. 31, *infra.*

27 See sources listed in Table 1 *supra.*

28 See EIA, *op. cit.*, fn. 5 *supra.*, at Table 58.2. Wind, solar thermal, and geothermal generation represent about 87 percent of California nonhydroelectric renewable generation in 2020.

29 See Table 1 and EIA, *op. cit.*, fn. 5 *supra.*, at Tables 55.2 and 58.2; and author computations. This is close to the $66.30 cost (excluding transmission) shown in Table 1 above for gas combined cycle generation. The other generation types are: coal (5.7 million mWh), petroleum (0.7 million mWh), natural gas (95.4 million mWh), nuclear (35.5 million mWh), and hydroelectric (32.9 million mWh). The

in 2020 will produce about 37.5 million mWh out of total generation of about 213.1 million mWh, or about 17.6 percent.[30] Since the 33 percent RPS requirement, if actually implemented, will force the nonhydroelectric renewable market share upward, and the conventional (predominantly gas-fired generation) market share downward, it will substitute higher-cost power in place of lower-cost power.[31]

The EIA projection of market shares in 2020 ignores the 33 percent RPS requirement in the context of total generation of 213 million mWh and total consumption of about 267 million mWh. Instead, in the EIA projections, total nonhydroelectric renewable generation (43 million mWh) is about 20 percent of total generation and 16 percent of consumption. The wind, solar thermal, and geothermal component (37.5 million mWh, or 87 percent) of that renewable portion is projected at about 17.6 percent of total generation, and 14 percent of consumption.

If the 33 percent RPS requirement is to be achieved, total nonhydroelectric renewable consumption would have to be 88 million mWh (33 percent of 267 million mWh of consumption), some of which would be imported. Under the assumption that imported renewable power imposes the same costs as renewable electricity generated in the state—this is a conservative assumption because transmission costs are almost certain to be higher—total consumer spending for the generation component of electric power deliveries in 2020 would be about $20.9 billion ($65 for 179 million mWh and $104.80 for 88 million mWh).[32]

Assume for purposes of simplicity no effect of the RPS costs on consumption. Total consumer spending for the generation component of electric power deliveries in 2020 without the extra costs imposed by wind, solar thermal, and geothermal power would be about $17.4 billion ($65 for 267 million mWh). Accordingly, the RPS requirement can be predicted to impose in 2020 an implicit tax of $3.5 billion—20 percent—on the generation component of the California electricity market by forcing the consumption of nonhydroelectric renewable power the weighted-average generation cost of which is over 60 percent higher than that of conventional gas generation. Averaged over the assumed 267 million mWh of consumption in 2020, the extra cost per mWh is about $13.11.

Summing the Higher Costs for Renewables. Table 3 below summarizes the higher costs imposed by the 33 percent RPS. In brief: A conservative estimate of the extra costs to be imposed upon the California power market in 2020 is about $5 billion.

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other components are transmission and distribution.

30 For purposes of simplicity, I ignore the issue of power imports in this narrow discussion. The implicit assumption is that in the pursuit of the RPS market share requirements, the marginal costs of power are equal whether produced within California or imported.

31 Accordingly, the EIA estimate of average year 2020 end-use prices for generation (about $64 per mWh) is biased downward because of the higher costs of renewables and their increased market share (from 17.6 percent to 33 percent) attendant upon achievement of the RPS mandates. This downward bias is exacerbated by the EIA assumption of transmission costs for wind and solar thermal power that are too low and by the absence of an adjustment for backup costs, as discussed above. See EIA, *op. cit.*, fn. 5 *supra.*, at Table 55.2. The EIA estimate of average transmission costs for geothermal power—$1.60 per mWh—almost certainly is too low as an estimate of marginal transmission cost, but there do not appear to be rigorous analyses of this question in the available literature. This issue is ignored here, an assumption that introduces a small bias that improves the assumed competitiveness of renewables.

32 Under a simple proportionality assumption (33/20), total nonhydroelectric renewable generation would be about 71 million mWh (=33/20 times 43), of which 62 million mWh (87 percent) would be wind, solar thermal, and geothermal, out of that total consumption of 267 million mWh. See EIA, *op. cit.*, fn. 5 *supra.*, at Table 55.2, and California Public Utilities Commission, *op. cit.*, fn. 14 *supra.*, at Fig. 1.

Table 3

Marginal Cost of the California 33 Percent RPS in 2020

(year 2011 dollars)

Cost Category	Amount per RPS mWh	Amount per total mWh	TOTAL (MILLIONS)
Transmission	10.70	3.53	941.6
Backup	12.50	2.06	550.0
Generation	39.77	13.11	3500.0
Total	62.97	18.70	4991.6

Source: Discussion in section III, *supra.*
Note: Assumed RPS mWh is 88 million (transmission and generation), 44 million (backup). Assumed total mWh is 267 million. $10.70 figure for transmission is nominal dollars pre-2011; a real figure in year 2011 dollars would be higher.
Note: Totals may not sum due to rounding.

If we compute a weighted total cost for generation and transmission using the EIA cost estimates by technology, the mix of generation technologies in 2012, and the EIA consumption projection for 2020, that total cost in 2020 would be about $18.5 billion (in year 2011 dollars).[33] The implicit tax of $5 billion imposed by the 33 percent RPS is 27 percent in 2020 relative to the same amount of electricity consumed, but produced with the 2012 technology mix.

That implicit tax will rise as the market grows. Consider a hypothetical future year in which power sales total 300 million mWh; this would be roughly the year 2032 under current projections. Under the 33 percent RPS, 100 million mWh would be obtained from all nonhydroelectric renewable sources, whether from in-state sources or from imports. Table 4 summarizes the higher costs in this hypothetical future year.

Table 4

Marginal Cost of the California 33 Percent RPS: 100 Million mWh Required

(year 2011 dollars)

Cost Category	Amount per RPS mWh	Amount per total mWh	Total (millions)
Transmission	10.70	3.57	1070.0
Backup	12.50	2.08	625.0
Generation	39.77	13.26	3977.0
Total	62.97	18.91	5672.0

Source: Previous discussion.
Note: Assumed RPS mWh: 100 million (transmission and generation), 50 million (backup). Assumed total mWh is 300 million.
Note: 10.70 figure for transmission is nominal dollars; does not net out transmission cost of CCG ($1.20 per mWh); these effects likely to cancel out.
Note: Totals may not sum due to rounding.

33 See references listed in Table 1, *supra.* The weighted cost for generation and transmission is about $69.40 per mWh. The consumption projection, again, is 267.4 million mWh.

The higher power costs imposed upon the state economy would be almost $5.7 billion. Comparing the findings reported in Tables 3 and 4, there is an increase in assumed electricity consumption from 267 million mWh to 300 million mWh, or 12.4 percent. The 12.4 percent increase in consumption yields an increase in the cost of the RPS of 13.6 percent. Over the longer term, the marginal cost of the RPS will rise proportionately with power consumption every year unless there is a decline in the relative cost of renewable power, a prospect for which there is little evidence in the cost trends, and which is highly dubious given current and prospective prices for natural gas.[34]

From Table 3, the marginal cost of the 33 percent RPS requirement in 2020 is $18.70 per total mWh. The EIA estimate of average California end-use prices in 2020 (in year 2011 dollars) is about $140 per mWh.[35] Whether directly or indirectly, rates and other costs borne by consumers, taxpayers, businesses, and other parties—ultimate consumer costs—must cover the marginal cost of the RPS mandates, even if those costs are hidden in part with various subsidies and other policy tools. Accordingly, whether directly or indirectly, rates in 2020 will rise by over 13 percent as a result of the 33 percent RPS requirement even if we use the EIA projection of the renewables market share as the baseline.

Note that California power rates are very likely to rise even in the absence of the costs imposed by the 33 percent RPS requirement. The Little Hoover Commission argues that

> In a June 2009 report, the [staff of the California Public Utilities Commission] estimated that average statewide electricity costs per kilowatt hour would rise by 16.7 percent by 2020 from 2008 levels *without additional investments in renewable energy*. [T]his increase reflected the need to maintain and replace aging transmission and distribution infrastructure, anticipated investments in advanced metering infrastructure and other smart grid capabilities, the cost of repowering or replacing generators to comply with once-through cooling regulations and the cost of procuring new conventional generating resources to meet increased electricity demand.[36]

This description of the sources of the 16.7 percent rate increase suggests strongly that is it real, that is, it is the prospective result not of general inflation but instead of the need for various investments driven by both economic and regulatory factors. Moreover, the California cap-and-trade program aimed at carbon dioxide and other "greenhouse gas" emissions, mandated by the 2006 Global Warming Solutions Act, will impose costs beginning at about $10 per ton in 2012, increasing thereafter on an annual basis. This will work out to roughly $5 per mWh, or approximately an additional 3 percent.[37] Accordingly, the extra costs to be imposed by the 33 percent RPS

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34 See Zycher, *op. cit.*, fn. 3 *supra.*, at 32-37 and 55-58.

35 As noted above, the EIA projection of market shares in 2020 assumes that total nonhydroelectric renewable generation (43 million mWh) will be about 20 percent of total generation and 16 percent of consumption. See EIA, *op. cit.*, fn. 5 *supra.*, at Tables 55.2 and 58.2.

36 Emphasis added. See Little Hoover Commission, "Rewiring California: Integrating Agendas for Energy Reform," December 2012, at http://www.lhc.ca.gov/studies/214/Report214_Final%20Complete.pdf, at 41. Note that this report emphasizes the adverse cost consequences not of the inherent uneconomic characteristics of renewable electricity, but instead of purportedly poor coordination among state government bureaucracies, an orientation that—to put it mildly—misses the forest for the trees.

37 See. e.g., http://blogs.kqed.org/climatewatch/2012/05/16/cap-and-trade-and-your-electric-bill/. Among the many silly arguments permeating the cap-and-trade debate in California is the assertion that residential power consumers will be protected from the costs of the cap-and-trade program under a rebate plan approved by the California Public Utilities Commission on December 20, 2012, under which some of the cap-and-trade revenues will be rebated toward residential rates or bills. See http://www.bloomberg.com/article/2012-11-16/aowI21KT9QTQ.html. For a particularly naïve presentation of this argument, see David R. Baker, "Cap and Trade May Be Plum For Homeowners," San Francisco Chronicle, November 16, 2012, at http://www.sfgate.com/science/article/Cap-and-trade-may-be-plum-for-homeowners-4045628.php. Obviously, such costs have to borne by someone—there are no free lunches—and if commercial and industrial consumers must bear the costs, inevitably they will be reflected in the prices paid by consumers for goods and

requirement will exacerbate cost increases that largely are independent of the RPS requirement itself. Californians between now and 2020 will be confronted with an overall increase in power prices and costs, whether direct or indirect, of approximately 33 percent. Table 5 summarizes these effects.

Table 5

Components of Prospective Rate Increases for California

Source	Rate Increase (percent)
Capital Investment: economic, regulatory	16.7
33 Percent RPS Mandate	13
Cap-and-Trade Costs	3
Total	32.7

Source: Previous discussion.

Table 6 presents data from the EIA on average regional retail electricity prices by end-use consumer class, for September 2012.

Table 6

Average End-Use Retail Electricity Prices, September 2012

(dollars per mWh)

Region	Residential	Commercial	Industrial	All Sectors
California	170.10	161.50	122.10	157.70
Oregon	100.40	83.70	57.40	81.80
Washington	87.90	76.20	42.10	68.20
Mountain	113.40	93.20	67.20	92.90
New England	158.60	138.20	122.80	142.10
Middle Atlantic	158.50	138.10	75.00	134.10
East North Central	122.90	96.00	66.30	93.50
West North Central	111.50	88.70	66.00	88.90
South Atlantic	116.70	94.20	67.40	99.50
East South Central	104.40	99.10	65.90	89.00
West South Central	105.70	80.50	55.80	84.40
U.S. Total	123.30	105.50	70.10	103.10

Source: Energy Information Administration, *Electric Power Monthly,* October 2012, Table 5.6.a, at http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_06_a.

For all sectors, California retail rates are 93-131 percent higher than those in the Pacific Northwest, and 70 percent higher than those in the Mountain region. They are 53 percent higher than those for the U.S. as a whole, a figure biased downward by high costs for Alaska and Hawaii.[38] Rates in other states and regions may rise as 2020 approaches, but the 33 percent RPS requirement in California is very likely to exacerbate rather than ease the state's relative price disadvantage.

services. Far from protecting residential consumers, the rebates would hide and/or shift the costs onto the consumers of the goods and services affected, many or all of whom are consumers of residential power services also.

38 For all sectors, the respective figures for Alaska and Hawaii are $164.00 and $343.30.

IV. Conclusions

Under a series of conservative assumptions, the California RPS requirement for a 33 percent market share for "renewable" electricity by 2020 will impose a marginal cost of about $5 billion that year. That is an implicit tax of 27 percent, resulting from the forced substitution of expensive power in place of cheaper electricity, particularly in terms of transmission, backup, and generation costs. That adverse effect—which inexorably will be reflected fully in rising costs paid by consumers—will grow proportionately with the size of the state electricity market over time, as the RPS requirement, if implemented, will force ever-greater amounts of high-cost power onto the market. For 2020, rates will rise by over 13 percent, whether directly or indirectly, exacerbating the price disadvantage characterizing the California electricity market, which already will confront rate increases of almost 20 percent even in the absence of the 33 percent RPS requirement. These costs to be imposed upon the state economy are real—after adjusting for inflation—and will strengthen the other important disadvantages that various public policies have created in terms of competitive dynamics with other states.[39]

Moreover, the arguments usually offered in support of RPS requirements, while not the focus of the discussion here, are far weaker than commonly assumed.[40] The data show that wind and solar technologies have achieved all available scale economies and learning efficiencies; accordingly, increases in the mandated market shares will not yield lower costs. Even if we assume technological advance for renewable power generation, that does not imply improved future competitiveness because technological advance is likely to characterize the evolution of conventional technologies as well. Renewable electricity receives federal financial support per mWh between twenty and over one thousand times that given conventional power; the RPS requirements do not "level the playing field"; and in any event the "subsidies" enjoyed by conventional generation as commonly cited by the proponents of RPS requirements actually are not "subsidies" defined properly. The backup costs for wind power are far greater than the costs of the adverse environmental effects of conventional electricity, even if we assume that current environmental regulation does nothing to reduce (or "internalize") the latter. And let us not ignore the environmental downside of wind power: dead birds, noise, flicker effects, unsightly land use, higher emissions from backup units, and so on. The usual "sustainability" argument in favor of renewables is incorrect simply as a matter of basic economics: Because the market rate of interest makes it profitable to conserve resources for future periods when prices might be higher, the fact that coal and gas are depletable is irrelevant. The "green jobs" argument ignores the adverse employment effects of the taxes needed to finance subsidies for renewable power, of the reduction in the size of the conventional power sector, and of the higher economic costs of an inefficient electric power system.

In short: The higher costs to be borne by the California economy will not be offset even in part by economic benefits. That the rising costs to be imposed upon the private sector might engender greater political opposition to the RPS requirements may be a source of hope for policy reform.

39 See, e.g., Arthur B. Laffer with Wayne Winegarden, *Eureka!: How to Fix California,* San Francisco: Pacific Research Institute, 2012.
40 See Zycher, *op. cit.*, fn. 3 *supra.*, at 32-54.

About the Author

Benjamin Zycher is a senior fellow at the Pacific Research Institute and a visiting scholar at the American Enterprise Institute. The views expressed are those of the author alone, and do not purport to represent those of the Pacific Research Institute, the American Enterprise Institute, or any of their respective officers or sponsors. Great gratitude is due Gary B. Ackerman, William R. Allen, Laurence A. Dougharty, Steven F. Hayward, Larry D. Hamlin, and Fereidoon P. Sioshansi for comments and suggestions, but any remaining errors are the responsibility of the author alone.

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