Prospective Employment Effects of California Proposition 23

Benjamin Zycher, Ph.D.

PACIFIC RESEARCH INSTITUTE

Prospective Employment Effects of California Proposition 23

A two-stage least squares and simulation analysis for 2010-2020

By Benjamin Zycher

Prospective Employment Effects of California Proposition 23
A two-stage least squares and simulation analysis for 2010-2020
By Benjamin Zycher
October 2010

Pacific Research Institute
One Embarcadero Center, Suite 350
San Francisco, CA 94111
Tel: 415-989-0833/ 800-276-7600
Fax: 415-989-2411
Email: info@pacificresearch.org
www.pacificresearch.org

Download copies of this study at www.pacificresearch.org.

CONTENTS

Acknowledgments 7

Executive Summary 9

I. Introduction: Energy and Employment 11

II. California Gross State Product, Employment, and Energy Consumption 13

III. Projections of Energy Use and Employment Under AB 32 15

IV. Further Observations on the Data 23

V. Conclusions: Increases in Aggregate California Employment if Proposition 23 Is Enacted 27

About the Author 29

Statement of Research Quality 30

About PRI 31

ACKNOWLEDGMENTS

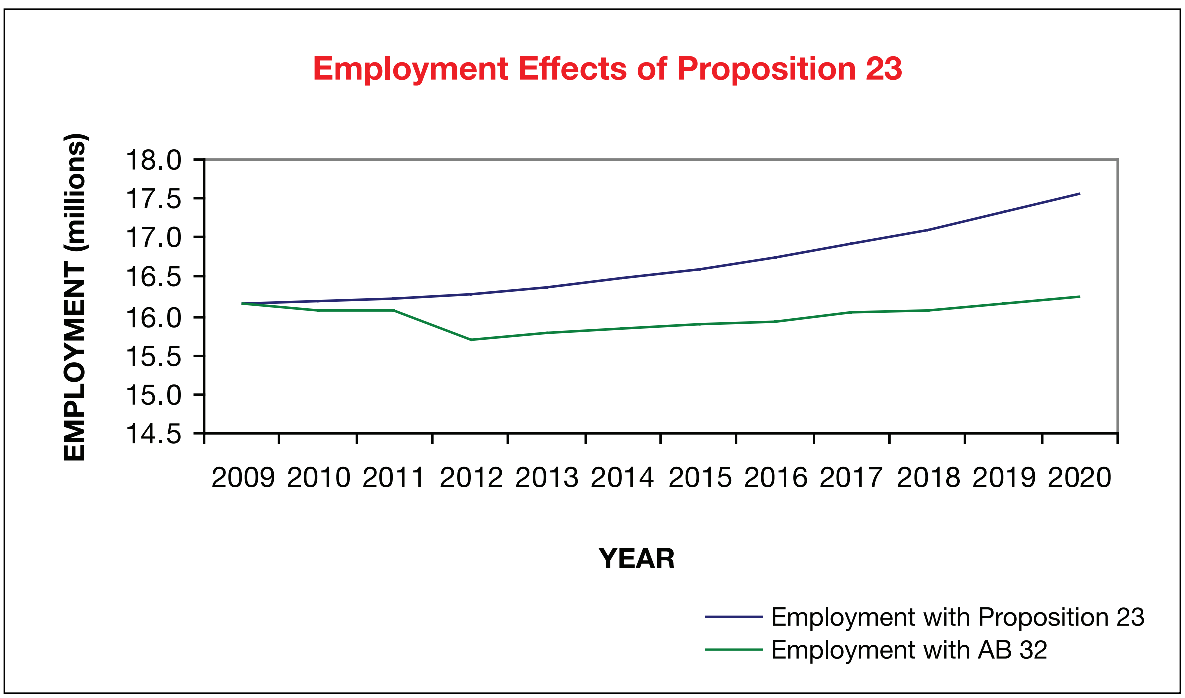
Sincere thanks are due Wayne T. Brough, Richard J. Buddin, Jason Clemens, Edward G. Keating, John R. Lott Jr., and Lawrence J. McQuillan for helpful suggestions; but any remaining errors are the responsibility of the author only. The views expressed do not purport to represent those of the Pacific Research Institute or of any of its officers or sponsors.

EXECUTIVE SUMMARY

If approved by the California electorate this November, Proposition 23 will suspend the implementation of the California Global Warming Solutions Act of 2006 (AB 32) until the California unemployment rate declines to 5.5 percent or less for four consecutive quarters. This study examines the historical relationship between employment and total energy consumption in California in order to derive projections of the prospective effects of Proposition 23 on employment. The estimates are based upon the future reductions in total energy consumption attendant upon the implementation of AB 32, as estimated by the staff of the California Air Resources Board (CARB).

The central finding of this study is that suspension of AB 32 would yield increases in aggregate California employment, relative to the case with implementation of AB 32, of a bit less than 150,000 in 2011, rising to more than a half million in 2012, and about 1.3 million in 2020. This assumes that four consecutive quarters of unemployment at 5.5 percent or less would not be observed, so that implementation of AB 32 would not resume. Long-term annual employment growth would fall by one percentage point. The ratio of employment to the population aged 18-65 in 2009 was 66.8 percent. If Proposition 23 is enacted, that ratio will rise to 67.5 percent in 2020; if AB 32 is implemented, it will fall to 62.4 percent in that year, an employment loss equal to about 5 percent of the working-age population.

The following figure illustrates the two alternative paths for total California employment.



There exists no evidentiary basis upon which to predict a fundamental change in the employment/energy relationship in the state. Like all geographic entities, California has certain long-term characteristics—climate, available resources, geographic location, trading partners, *ad infinitum*—that determine in substantial part the long-run comparative advantages of the state in terms of economic activities and specialization. It certainly is possible that the historical relationship between California employment and energy consumption will change. Technological advances are certain to occur, but the prospective nature and effects of those shifts are difficult to predict. The California economy may evolve over time in ways yielding important changes in the relative sizes of industries and sectors; but, again, the direction of the attendant shifts in energy use and employment is ambiguous. More broadly, the record over three decades shows that the employment/energy relationship in California may be increasing more slowly than was the case before the mid-1980s, but there is no evidence that it is declining.

The available data, while published by federal and state agencies, nonetheless are subject to the usual array of measurement errors and the contrasting biases inherent in alternative estimation methodologies. Moreover, econometric models always represent some combination of science and art. Nonetheless, sound economic analysis provides no basis upon which to predict that the employment effects of AB 32 would be positive, a reality directly relevant to the choices now facing public officials and the California electorate.

I. INTRODUCTION: ENERGY AND EMPLOYMENT

If approved by the California electorate this November, Proposition 23 would suspend the implementation of the California Global Warming Solutions Act of 2006 ("AB 32") "until the California unemployment rate declines to 5.5 percent or less for four consecutive quarters."[1] Given the increasingly controversial nature of the scientific and economic analyses underlying policy proposals ostensibly directed at the purportedly adverse effects of greenhouse gas emissions,[2] and given the economic and employment conditions now characterizing the state, the employment effects of AB 32 have become an important political and policy concern.

This paper uses the historical relationships among employment, aggregate output, the capital stock, and total energy consumption for California to derive projections of the effect of AB 32 upon aggregate employment in the state for the period 2010-2020. These projections yield the derived employment effects of Proposition 23; as noted above, the assumption is that the implementation of AB 32 would be suspended for the entire period.

The employment effects of AB 32 have become an important political and policy concern.

1 See the California Secretary of State at http://www.voterguide.sos.ca.gov/propositions/23/title-summary.htm. For the 138 quarters over the period 1976:1 through 2010:2, an unemployment rate of 5.5 percent was achieved in no more than 32 quarters, or about 23 percent of the time. These were in three concentrated periods: 1987:4 through 1990:2, 1999:1 through 2001:3, and 2005:2 through 2007:3. See the Bureau of Labor Statistics tables at http://data.bls.gov/cgi-bin/dsrv?la. This paper assumes that the 5.5 percent/four quarter threshold will not be achieved over the 2010-2020 period; but the possibility that it might be reached, and thus that implementation of AB 32 would resume, suggests that Proposition 23 would have effects on private sector incentives different from those that would be yielded by a repeal of AB 32. These differences would be likely to be most important in the context of investment. This complication is ignored here.

2 See, e.g., Patrick J. Michaels and Robert C. Balling, Jr., *Climate of Extremes: Global Warming Science They Don't Want You to Know* (Washington DC: Cato Institute, 2009); Richard S. Lindzen and Yong-Sang Choi, "On the Determination of Climate Feedbacks From ERBE Data," *Geophysical Research Letters*, vol. 36 (August 26, 2009); A. W. Montford, *The Hockey Stick Illusion: Climategate and the Corruption of Science*, (London: Stacey International, 2010); Roy W. Spencer, *The Great Global Warming Blunder: How Mother Nature Fooled the World's Top Climate Scientists* (New York: Encounter Books, 2010); and Sally C. Pipes and Benjamin Zycher, "Attorneys General Versus the EPA," Pacific Research Institute monograph, December 2003, at https://www.pacificresearch.org/publications/id.174/pub_detail.asp.

II. CALIFORNIA GROSS STATE PRODUCT, EMPLOYMENT, AND ENERGY CONSUMPTION

Since AB 32 is intended to reduce the emissions of greenhouse gases,[3] it is equivalent analytically to implementation of a tax on conventional energy use, regardless of the specific nature of the regulations and constraints. The statistical analysis discussed below employs three cases defined by the California Air Resources Board (CARB): a reference case (no implementation of AB 32 policies), and cases 1 and 5 (the weakest and strongest regulatory interventions, respectively, delineated by the CARB estimate of the implicit price (or tax) per ton of carbon dioxide-equivalent).[4] Table 1 presents the CARB staff analysis of the implied percent energy price increases by fuel and aggregate subsector under cases 1 and 5.

Table 1. Implicit Energy Price Effects of AB 32 (percent)

Sector/Fuel	Case 1	Case 5
Residential		
Electric	-0.1	13.4
Gas	11.0	49.3
Oil	7.3	35.7
LPG	3.1	15.2
Commercial		
Electric	0.1	14.6
Gas	12.3	56.2
Oil	8.2	40.4
LPG	3.7	18.4
Industrial		
Electric	0.2	16.8
Gas	9.9	44.8
Coal	75.1	369.7
Oil	5.8	28.3
Transportation		
Gasoline	5.4	32.2
Diesel	3.1	22.6

Source: See footnote 4.

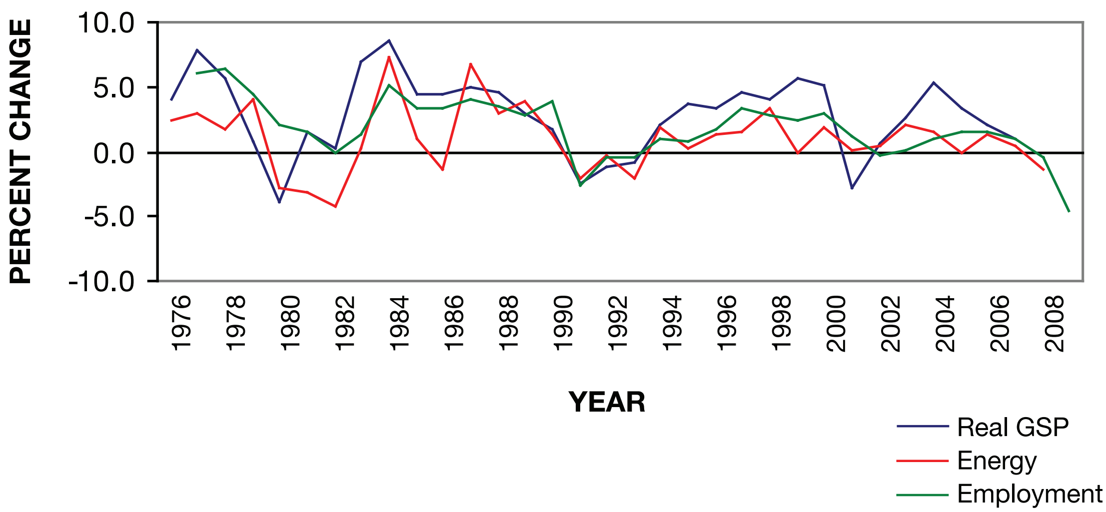
Note: LPG – liquefied petroleum gas.

3 The specific requirement is a reduction in emissions to 1990 levels by 2020. This would be a reduction of about 25-30 percent; the per capita reduction would be greater.

4 Source: Private communication by the author with CARB staff. For cases 1 and 5, the implicit taxes per ton of carbon dioxide-equivalent are, respectively, $21 and $102. That these implicit taxes are not trivial is suggested by the current market price of per-ton allowances—$0.10 as of September 17, 2010—at the Chicago Climate Exchange. See http://www.chicagoclimatex.com/market/data/daily.jsf.

At an aggregate level, broad classes of inputs—labor, capital, and energy—can be substitutes, complements, or, depending on the industry or sector, both. Because this analysis is concerned with the prospective implications of AB 32 on employment, it is the labor/energy relationship that is of central interest. Figure 1 shows the path of percent changes in California real gross state product (GSP), total employment, and total energy use for the period 1976-2009.[5]

Figure 1. California Output, Energy Use, Employment



It is obvious from the aggregate trends that energy use and employment are complementary rather than substitutes; the simple correlation between the percent changes for the two is 0.62, meaning, crudely, that a positive (percent) change in one tends to be observed with a positive change in the other.[6] Note, as well, that the simple output/energy and output/employment correlations are 0.58 and 0.64, respectively.

Implementation of AB 32—a tax on energy use—would reduce employment by increasing the cost of energy.

The correlations by themselves are not evidence of causation, the determination of which requires application (and statistical testing) of a conceptual framework. But the data displayed in Figure 1 make it reasonable to hypothesize that implementation of AB 32—a tax on energy use—would reduce employment by increasing the cost of energy.[7] Section III discusses a simple econometric model of California aggregate employment and energy use, and then offers some quantitative projections based on a simulation analysis.

---

5 Sources: For California real gross state product, U.S. Bureau of Economic Analysis at http://bea.gov/regional/gsp/, California Department of Industrial Relations at http://www.dir.ca.gov/dlsr/CPI/EntireCCPI.PDF, and author computations. For California total energy consumption, U.S. Energy Information Administration at http://www.eia.doe.gov/emeu/states/sep_use/total/pdf/use_ca.pdf. For California employment, U.S. Bureau of Labor Statistics at http://data.bls.gov/cgi-bin/dsrv?la.

6 Were they substitutes, the simple correlation would be negative.

7 Note that the increased "efficiency" of energy use ostensibly yielded by the use of more "energy-efficient" capital does not necessarily yield a reduction in aggregate costs, in that the cost of the capital must be compared with the present value of any energy cost savings.

III. PROJECTIONS OF ENERGY USE AND EMPLOYMENT UNDER AB 32

Table 2 presents the CARB projections of California energy consumption for 2010-2020 for the reference case, cases 1 and 5, and for the average of the latter two.

Table 2. California Energy Consumption (trillion btu)

Year	(1) Reference	(2) Case 1	(3) Case 5	(4) Case 1/5 Average	(5) (1)-(4)	(6) Percent
2010	7102.4	7035.3	7074.4	7054.8	47.6	-0.7
2011	7124.8	7007.6	7083.3	7045.5	79.4	-1.1
2012	7125.9	6909.4	6730.8	6820.1	305.7	- 4.5
2013	7171.0	6954.6	6779.1	6866.8	304.2	- 4.4
2014	7229.6	6970.9	6811.2	6891.0	338.6	- 4.9
2015	7291.5	7005.2	6837.9	6921.5	369.9	-5.3
2016	7320.5	7000.4	6814.7	6907.5	413.0	-6.0
2017	7343.4	6998.9	6792.1	6895.5	447.9	-6.5
2018	7388.9	7000.3	6746.4	6873.3	515.6	-7.5
2019	7426.9	6995.0	6690.8	6842.9	584.0	-8.5
2020	7484.6	7008.9	6672.1	6840.5	644.1	-9.4

Source: See footnote 4; and author computations.

The economic literature on "real business cycles" offers a body of empirical findings on the correlation between volatility in energy prices and volatility in output and employment. As a crude generalization, the literature finds only a small correlation, in part because, as noted by In-Moo Kim and Prakash Lougani, "the share of energy in GNP is so small that it would require implausible parameter values to generate strong aggregate impacts from energy price shocks."[8] Note, again, that this literature in the context of employment effects emphasizes the correlation between the volatility of energy prices and the volatility of aggregate output and employment (or hours worked). The

8 See In-Moo Kim and Prakash Lougani, "The Role of Energy in Real Business Cycle Models," *Journal of Monetary Economics*, vol. 29, no. 2 (April 1992), pp. 173-189. For a useful summary of real business cycle models, see Ellen R. McGrattan, "Real Business Cycles," in Steven N. Durlauf and Lawrence E. Blume, eds., *The New Palgrave Dictionary of Economics*, second edition, Palgrave MacMillan, 2008. Note that Hamilton finds that sharp increases in the price of oil yield much larger aggregate output and employment effects. See James D. Hamilton, "Nonlinearities and the Macroeconomic Effects of Oil Prices," June 14, 2010, at http://dss.ucsd.edu/~jhamilto/oil_nonlinear_macro_dyn.pdf; and James D. Hamilton, "Oil Prices and the Economic Downturn," testimony prepared for the Joint Economic Committee of the U.S. Congress, May 20, 2009, at http://econbrowser.com/archives/2009/05/Hamilton_JEC_2009_05_20.html.

direct effect of changes in energy prices on employment is not a parameter usually estimated. James D. Hamilton, however, finds that the increases in the market price of oil observed in 2007-2008 explain much of the decline in real U.S. GDP in the fourth quarter of 2008.[9]

The real business cycle literature treats the U.S. economy as one aggregate entity; in effect, workers cannot leave the country. But that is an implausible conceptual constraint in the context of the implementation of AB 32, for which it is useful to distinguish between short-term and long-term effects. The long term is a period of time sufficient to allow employers and workers to move among states, that is, labor markets; it is not necessarily a long period of time. In the short term, one might expect an increase in energy prices to yield a decline in wages, given that energy and labor are complementary inputs, as noted above.[10] But since the implementation of AB 32 is limited to California, the resulting downward pressure on wages over time would engender a migration to other states by employers and employees seeking to avoid the implicit tax imposed by AB 32, a dynamic outcome that real business cycle analysis tends to shunt aside.

The resulting downward pressure on wages over time would engender a migration to other states by employers and employees seeking to avoid the implicit tax imposed by AB 32.

One way to examine this issue is to estimate a model of the effect of energy use on employment in California. Consider an economy in which productive activities are driven by market demands for final goods and services. This means that the employment of workers, the use of energy inputs, and investments in capital assets are "derived" from those final market demands. The economy has certain long-term characteristics: weather, resource endowments, a pre-existing legal and political system, and the like. For purposes of analysis, in the context of AB 32, the inputs can be aggregated usefully as labor, capital, and energy.

A large economy such as that of California begins any given time period with a stock of productive capital, with a labor force displaying some set of such characteristics as the age distribution, skill set, and the like—in a word, its productivity—and with some fixed energy infrastructure. These aggregate classes of inputs thus are "predetermined" in any given time period, although certainly their respective characteristics change over time in response to shifts in market conditions and expectations, technological advances, population migrations, and a myriad other factors. Indeed, some kinds of characteristics can change quickly; examples are energy consumption, the effects of labor migration on the size of the labor force, and the like.

Clearly, employment is driven in substantial part by aggregate output, that is, by real gross state product (GSP). Similarly, because employment and energy are complements—workers use energy to accomplish their tasks—employment and energy consumption drive each other. Moreover, gross state product is determined in part by the stock of productive capital and by economic conditions

9 See James D. Hamilton at http://www.econbrowser.com/archives/2009/04/consequences_of.html.

10 Two inputs are complements if an increase in the price of one yields a decline in the demand for the second. An increase in energy costs would reduce energy consumption, thus lowering the productivity of (or the demand for) labor, putting downward pressure on wages.

(gross domestic product) in the rest of the country. Accordingly, we have the following simple structural model:

Employment = F(energy, GSP, capital stock, non-CA GDP)

Note that we are not estimating GSP as a function of the other variables, because that model would not make sense in terms of the underlying behavioral economics. The use of (demand for) energy, labor, and capital are derived from the underlying demands for final outputs, and not the reverse.[11]

Table 3 presents the findings from a two-stage least squares analysis of California total employment. The right-hand variables in the structural equation are energy use, GSP, the capital stock (private nonresidential fixed assets), and non-California GDP. The latter two variables are assumed exogenous in the two-stage model. All equations are estimated in the natural logarithms of the respective data, so that the estimated coefficients are elasticities. The data are for 1976 through 2007; the reported numbers in parentheses are t-statistics.[12]

Table 3. Dependent Variable: Total Employment Estimated Coefficients (t-statistics)

Variable	-------------------------equation------------------------			
	(1)	(2)	(3)	(4)
Energy	0.78	0.28	1.07	0.81
	(11.72)	(0.94)	(638.0)	(11.49)
GSP	0.36			
	(4.34)			
Capital		0.96		
		(2.64)		
Non-CA GDP				0.25
				(3.63)

Source: Author computations.

11 Consider as a simple example the market for shoes. Investments in shoe factories and associated human capital are made because there is a market demand for shoes. There is not a demand for shoes because of the existence of shoe factories and shoe-producing labor.

12 In addition, we constrain the constant term in the employment equation at zero because zero energy use, zero GSP, zero capital, and zero non-California GDP would yield employment of zero. For employment we use data from the U.S. Bureau of Labor Statistics at http://data.bls.gov/cgi-bin/dsrv?la. For California total energy consumption, we use data from the U.S. Energy Information Administration at http://www.eia.doe.gov/emeu/states/sep_use/total/pdf/use_ca.pdf. For real California GSP, we use data from the U.S. Bureau of Economic Analysis at http://bea.gov/regional/gsp/ and data from the California Department of Industrial Relations at http://www.dir.ca.gov/dlsr/CPI/EntireCCPI.PDF. For private fixed nonresidential assets (i.e., the capital stock), we use data from the U.S. Bureau of Economic Analysis at http://bea.gov/national/FA2004/SelectTable.asp#54, weighted by the ratio of real California GSP to real U.S. GDP, found at http://www.bea.gov/national/#gdp. Non-California GDP is derived as the difference between U.S. GDP and California GSP.

In three of the four equations, energy use is significant both economically and statistically in its estimated effect upon employment. The exception is equation 2, in which the coefficient on energy use does not differ from zero as a matter of statistical significance. This is likely to be a result of high collinearity between energy use and capital—the simple correlation is 0.95—as almost all fixed capital uses energy in some form, so that in the time series changes in the stock of fixed capital would be associated closely with changes in energy use.

From estimated equations (1) and (4), we find an elasticity of California employment with respect to energy use of about 0.8; this means that a reduction in energy consumption of 10 percent would yield a reduction in employment of about 8 percent. Since, as a very crude approximation, a 10 percent reduction in energy use would imply substantial underlying price increases—25 percent or more[13]—this large adverse employment effect is wholly plausible.[14]

Table 4 presents historical data on California total employment for 1976 through 2009.

Table 4. California Employment: Historical (thousands)

Year	Employment	Year	Employment
1976	8979.8	1992	13874.2
1977	9518.0	1993	13808.3
1978	10132.8	1994	13953.9
1979	10573.5	1995	14062.4
1980	10791.4	1996	14303.5
1981	10947.7	1997	14780.8
1982	10931.1	1998	15203.7
1983	11083.7	1999	15566.9
1984	11643.4	2000	16024.3
1985	12030.5	2001	16220.0
1986	12434.2	2002	16180.8
1987	12943.4	2003	16200.1
1988	13388.3	2004	16354.8
1989	13770.6	2005	16592.2
1990	14294.1	2008	16938.3
1991	13931.7	2009	16163.9

Source: U.S. Bureau of Labor Statistics at http://data.bls.gov/cgi-bin/dsrv?la.

13 For a detailed discussion of estimated energy demand elasticities, see Mark A. Bernstein and James Griffin, *Regional Differences in the Price-Elasticity of Demand For Energy*, (Santa Monica: RAND Corporation, 2005), at http://www.rand.org/pubs/technical_reports/2005/RAND_TR292.pdf.

14 From Table 1 we see that the CARB estimates of the implicit energy price increases as averaged between cases 1 and 5 range between 6.7 percent and 34.3 percent, excluding the figures for coal.

Note that the compound annual employment growth rates for the 10-year period 1997-2007 and for the 20-year period 1987-2007 were, respectively, 1.41 percent and 1.38 percent. Table 5 (column 2) presents employment projections for the period 2010-2020 under the assumption that employment growth in the absence of AB 32 will rise smoothly from 2009 over the ensuing decade, reaching 1.4 percent in 2020 (column 1); and then applies the CARB projections on reductions in energy consumption (from Table 2 above) to our employment elasticity estimate of 0.8 to derive the projected effects of AB 32 on California employment.

Table 5. Projected California Employment(thousands)

Year	(1) Employment Growth Rate (percent)	(2) Employment wthout AB 32	(3) Energy Change (percent)	(4) Employment Effect (percent)	(5) Employment with AB 32	(6) Employment Effect
2009	-----	16163.9	-----	-----	16163.9	-------
2010	0.13	16184.9	-0.7	-0.6	16087.8	-97.1
2011	0.25	16225.4	-1.1	-0.9	16079.4	-146.0
2012	0.38	16287.0	-4.5	-3.6	15700.7	-586.3
2013	0.51	16370.1	-4.4	-3.5	15797.1	-573.0
2014	0.63	16473.2	-4.9	-3.9	15830.8	-642.5
2015	0.76	16598.4	-5.3	-4.2	15901.3	-697.1
2016	0.89	16746.1	-6.0	-4.8	15942.3	-803.8
2017	1.02	16917.0	-6.5	-5.2	16037.3	-879.7
2018	1.14	17109.8	-7.5	-6.0	16083.2	-1026.6
2019	1.27	17327.1	-8.5	-6.8	16148.9	-1178.2
2020	1.40	17569.7	-9.4	-7.5	16252.0	-1317.7

Sources: U.S. Bureau of Labor Statistics at http://data.bls.gov/cgi-bin/dsrv?la, Table 2, Table 3, and author computations.
Note: 2009 data are actual.

With the implementation of AB 32, projected employment in 2012 declines sharply, driven by the CARB projection of a 4.5 percent decrease in total energy consumption (the average of cases 1 and 5 from Table 2). That is followed by employment increasing at an annual compound rate of 0.4 percent between 2012 and 2020. As noted above, the annual compound employment growth rate for the 10- and 20-year periods ending in 2007 was about 1.4 percent.[15]

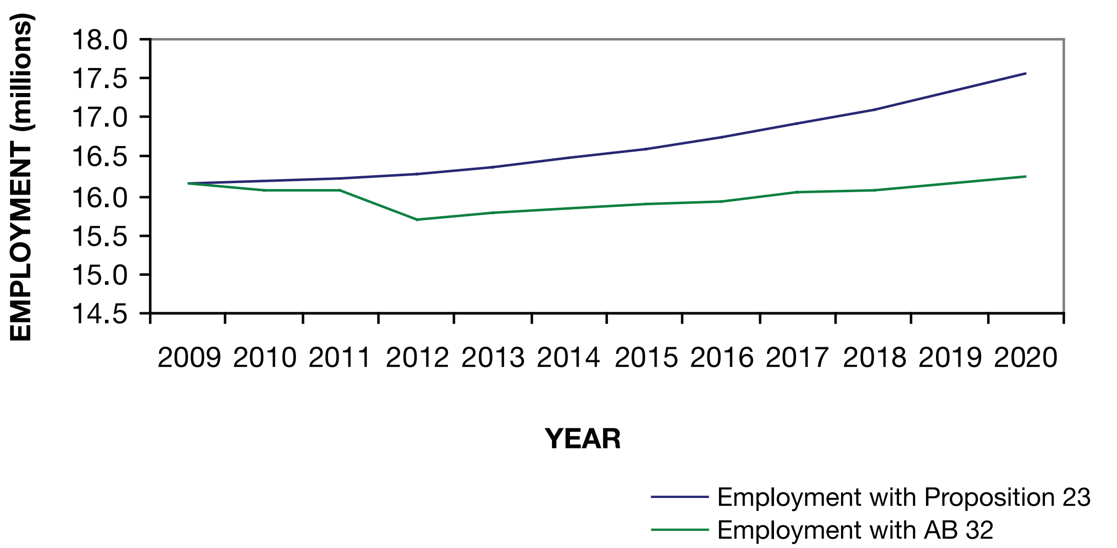
With the implementation of AB 32, projected employment in 2012 declines sharply, driven by the CARB projection of a 4.5 percent decrease in total energy consumption.

15 As discussed above, our assumption is more conservative, postulating a gradual increase in the annual growth of total employment to 1.4 percent in 2020 in the absence of AB 32.

Accordingly, the CARB projections of energy consumption under AB 32, combined with the econometric analysis of the relationship between California employment and energy consumption reported above, suggest that AB 32 will reduce long-term annual employment growth by about one percentage point, total employment by more than a half million in 2012, and about 1.3 million in 2020. Figure 2 displays these paths.

AB 32 will reduce long-term annual employment growth by about one percentage point, total employment by more than a half million in 2012, and about 1.3 million in 2020.

Figure 2. Employment Effects of Proposition 23



A suspension of AB 32 would result in an increase in employment as a proportion of the population aged 18-65 from 66.8 percent in 2009 to 67.5 percent in 2020.

This projected decline in California employment attendant upon the implementation of AB 32 can be compared with Census Bureau projections of the growth in the California population aged 18-65. From Table 6 we see that a suspension of AB 32 would result in an increase in employment as a proportion of the population aged 18-65 from 66.8 percent in 2009 to 67.5 percent in 2020 (column 4). With the employment losses caused by AB32, the ratio declines in 2020 to 62.4 percent (column 5), an employment loss equal to about 5 percent of the working-age population.

Table 6. Employment and the Population Aged 18-65

Year	(1) Pop. 18-65 (000s)	(2) Employed (Prop. 23)	(3) Employed (AB 32)	(4) (2)/(1) (percent)	(5) (3)/(1) (percent)	(6) Difference (percent)
2009	24185.7	16163.9	16163.9	66.8	66.8	-----
2010	24471.5	16184.9	16087.8	66.1	65.7	0.4
2011	24736.2	16225.4	16079.3	65.6	65.0	0.6
2012	24978.2	16287.0	15700.7	65.2	62.9	2.3
2013	25157.2	16370.1	15797.1	65.1	62.8	2.3
2014	25320.6	16473.2	15830.8	65.1	62.5	2.6
2015	25462.1	16598.4	15901.3	65.2	62.5	2.7
2016	25571.4	16746.1	15942.3	65.5	62.3	3.2
2017	25683.1	16917.0	16037.3	65.9	62.4	3.5
2018	25792.6	17109.8	16083.2	66.3	62.4	3.9
2019	25915.3	17327.1	16148.9	66.9	62.3	4.6
2020	26031.2	17569.7	16252.0	67.5	62.4	5.1

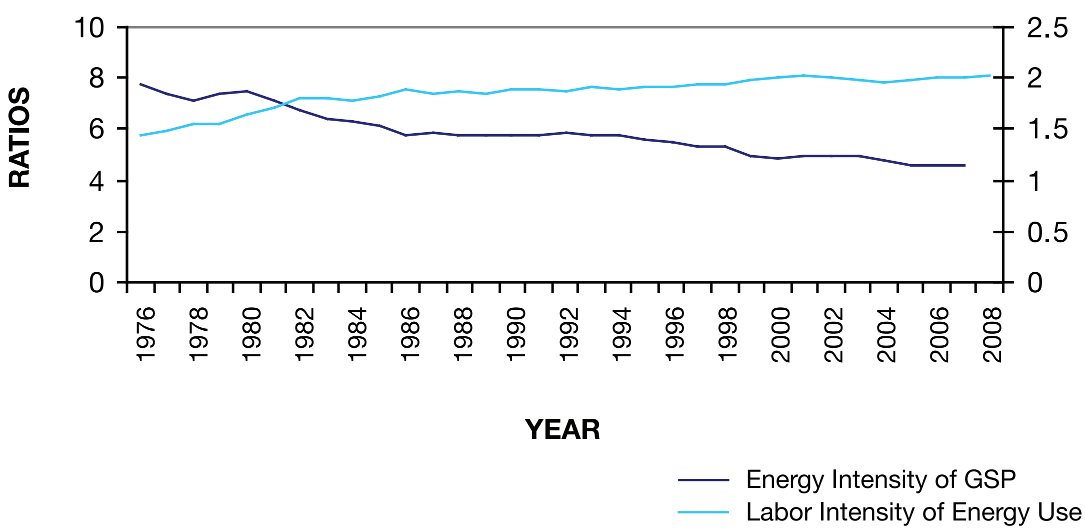
Sources: U.S. Census Bureau at http://www.census.gov/population/www/projections/projectionsagesex.html; Table 5; and author computations.

IV. FURTHER OBSERVATIONS ON THE DATA

It certainly is possible that the historical relationship between California employment and energy consumption will change. Technological advances are certain to occur, but the prospective nature and effects of those shifts are difficult to predict.[16] The California economy may evolve over time in ways yielding important changes in the relative sizes of industries and sectors; but, again, the direction of the attendant shifts in employment and energy use, both in the aggregate and in terms of the fuel mix, is ambiguous.[17]

But there exists no evidentiary basis upon which to predict a fundamental change in the employment/energy relationship in the state. Like all geographic entities, California has certain long-term characteristics—climate, available resources, geographic location, trading partners, *ad infinitum*—that determine in substantial part the long-run comparative advantages of the state in terms of economic activities and specialization. Figure 3 presents the historical paths of the energy intensity of California GSP (BTUs per dollar of output) and of the labor intensity of California energy use (employment per BTU).

Figure 3. California Energy Relationships



---

16 Note that greater energy "efficiency" in any given activity can yield an increase in actual energy consumption, if the elasticity of energy demand with respect to the marginal cost of energy use is greater than one. If, for example, air conditioning were to become sufficiently "efficient" in terms of energy consumption, it is possible that air conditioners would be run so much that total energy consumption in space cooling would increase. A tax, on the other hand, whether explicit or implicit, increases the price of energy use, and so unambiguously reduces energy consumption.

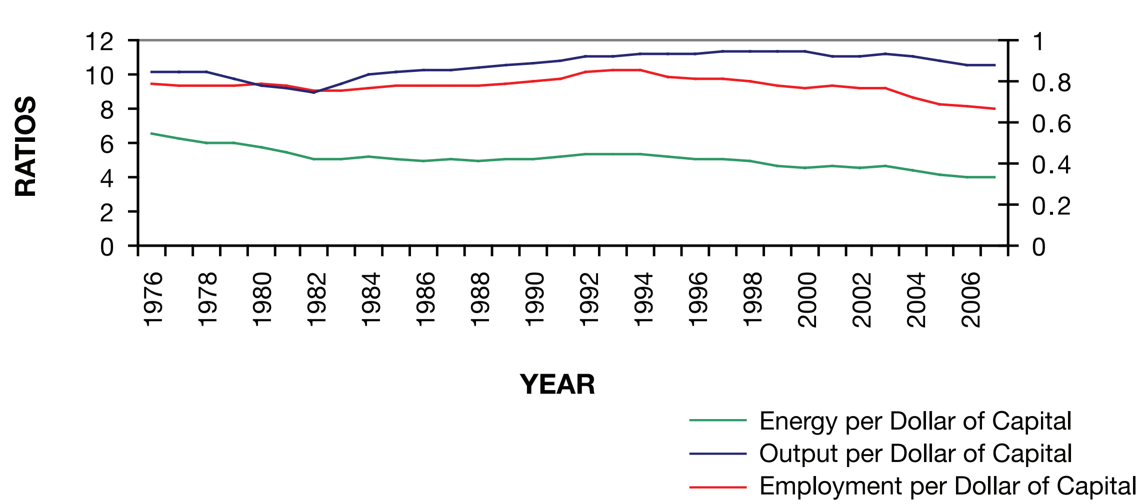
17 Subsidies for such "renewable" sources of energy as wind and solar power often are justified in part on the premise that once in operation, the new energy subsectors will be able to compete with traditional energy suppliers. See, e.g., the various discussions at http://www.energy.ca.gov/renewables/index.html. This raises the question of why markets cannot foresee such competitiveness and make the appropriate investments *ex ante*, a topic outside the scope of this study.

The energy intensity of California output (left-hand scale) has declined more-or-less monotonically since the mid-1970s, at a compound average annual rate of 1.7 percent.[18] This unquestionably is due in substantial part to the long-term effects of energy price increases, technological advances, and shifts in the composition of California economic output. But the labor intensity of California energy use—in effect, the employment "supported" by each increment of total energy consumption—increased between the mid-1970s to the mid-1980s at a compound annual average rate of about 2.8 percent.[19] Since 1986, it has been essentially unchanged, rising at a compound annual rate of less than 0.3 percent per year. In short, while the employment/energy relationship may be increasing more slowly than was the case before the mid-1980s—or even may be constant given the problems that always characterize the published data—there is no evidence that it is declining.

While the employment/ energy relationship may be increasing more slowly than was the case before the mid-1980s, there is no evidence that it is declining.

With respect to fixed capital assets, Figure 4 below illustrates some interesting relationships. GSP per dollar of capital (right-hand scale) is essentially unchanged over the 1976-2007 period, rising from 0.85 to 0.88; given, again, the rough nature of the data, this suggests that the productivity of capital in the aggregate has been constant. Energy consumption per dollar of capital has declined by more than a third, from 6.6 in 1976 to 4.0 in 2007, reflecting the obvious increase in the energy efficiency of the capital stock over the past three decades. But employment per dollar of capital has declined only modestly, from 9.5 in 1976 to 8.0 in 2007. This is a decline of 0.5 percent per year, which may not differ from zero in an economic sense given, again, the nature of the data.

Figure 4. Fixed Capital Relationships



18 The energy intensity of California GSP was 7.78 in 1976 and 4.57 in 2007.

19 The labor intensity of California energy use was 1.45 in 1976, 1.90 in 1986, and 2.02 in 2008.

These data illustrated in Figures 3 and 4 suggest that labor may be substituting for energy as a complement in the employment of capital. In other words, market forces may have yielded an increase in the demand for labor, the opposite of the effect of (implicit) taxes on energy.[20] Alternatively, this may be an illusion; the data may obscure some separate fundamental long-term economic trends. But there is no evidence that the complementarity of energy consumption and employment is becoming weaker in California. Accordingly, it is reasonable to use the evidence on that past relationship to make inferences about the future effects of policy implementation, with full recognition of the substantial uncertainties and potential for the unforeseen always relevant to such projections.

There is no evidence that the complementarity of energy consumption and employment is becoming weaker in California. Accordingly, it is reasonable to use the evidence on that past relationship to make inferences about the future effects of policy implementation.

20 See, *supra.,* the discussion of real business cycle models.

V. CONCLUSIONS: INCREASES IN AGGREGATE CALIFORNIA EMPLOYMENT IF PROPOSITION 23 PASSES

The historical evidence suggests that Proposition 23, by suspending the implementation of AB 32, would yield increases in aggregate California employment of almost 150,000 in 2011, rising to more than a half million in 2012, and about 1.3 million in 2020. This assumes that four consecutive quarters of unemployment at 5.5 percent or less would not be observed, so that implementation of the California Global Warming Solutions Act of 2006 would not resume. The available data are subject to the usual array of measurement errors and the contrasting biases inherent in alternative estimation methodologies, and econometric models always represent some combination of science and art. Nonetheless, sound economic analysis provides no basis upon which to predict that the employment effects of AB 32 would be positive, a reality directly relevant to the choices now facing public officials and the California electorate.

ABOUT THE AUTHOR

Benjamin Zycher, a PRI senior fellow, has also served as a senior economist at the RAND Corporation, an adjunct professor of economics at the University of California, Los Angeles, an adjunct scholar at the Cato Institute, and a senior fellow at the Manhattan Institute. During the first two years of the Reagan administration, Dr. Zycher served as a senior staff economist on the president's Council of Economic Advisers.

Dr. Zycher's previous work for PRI includes *"Entrepreneurs' Coverage": An Alternative Health Policy Reform,* and *Costs and Consequences: Rate-of-Return Biases, Rate Suppression, and Market Incentives for Quality in Property/Casualty Insurance Regulation*. With PRI President Sally Pipes he co-authored *Pharmaceuticals and Price Controls* and *Attorneys General versus the EPA*. Dr. Zycher has also conducted considerable research on energy, the environment, and the effects of government regulation, taxation, spending, and debt.

He is the author, with Charles Wolf Jr. et al., of *Fault Lines in China's Economic Terrain* and, with Tad Daley, of *Military Dimensions of Communist Systems*. His many publications include the "Defense Economics" and "OPEC" entries in *The Concise Encyclopedia of Economics* (2008), and "Comparing Public and Private Health Insurance: Would a Single-Payer System Save Enough to Cover the Uninsured?" and "The Human Cost of Federal Price Negotiations: The Medicare Drug Benefit and Pharmaceutical Innovation," both for the Manhattan Institute. He also co-authored "The Truth about Drug Innovation: Thirty-Five Summary Case Histories on Private Sector Contributions to Pharmaceutical Science" (June 2008) and was sole author of "HSA Health-Insurance Plans after Four Years: What Have We Learned?" (February 2009), both Manhattan Institute Medical Progress Reports.

Dr. Zycher's articles have appeared in *Investor's Business Daily*, *Reason*, *The Hill*, and the *Wall Street Journal*, *Washington Times*, *Los Angeles Times*, *Orange County Register*, *San Diego Union-Tribune*, and many other publications. He serves on the advisory board of the quarterly journal *Regulation*, in which his work has also appeared.

Benjamin Zycher holds a Ph.D. in economics from the University of California, Los Angeles, where he also earned his bachelor's degree in political science. He also holds a master of public policy degree from the University of California, Berkeley.

STATEMENT OF RESEARCH QUALITY

The Pacific Research Institute is committed to accurate research and, to that end, submits all new PRI studies for review by a minimum of two researchers with expertise in the subject area, including a minimum of one external expert. To adjudicate any unresolved difference, deemed reasonable and substantive, between an author(s) and a reviewer, PRI maintains a Research Review Board (RRB). The RRB has final and determinative authority, and includes the following scholars:

Professor Robert Barro, Harvard University
Professor William Boyes, Arizona State University
Professor Steve Globerman, Western Washington University
Professor Jay Greene, University of Arkansas
Professor James Gwartney, Florida State University
Professor Eric A. Hanushek, Stanford University
Professor David Henderson, Naval Postgraduate School (Monterey)
Dr. W. Lee Hoskins, former president, Federal Reserve Bank of Cleveland (retired)
Professor Ronald W. Jones, University of Rochester
Professor Lynne Kiesling, Northwestern University
Professor Edward Lopez, San Jose State University
Professor Ross McKitrick, University of Guelph (Canada)
Professor Sandra Peart (Dean), University of Richmond
Professor David Schmidtz, University of Arizona
Professor Paul Zak, Claremont Graduate University

As part of its commitment, the Institute guarantees that all original factual data are true and correct to the best of our knowledge and that information attributed to other sources is accurately represented. If the veracity of any material fact or reference to an independent source is questioned and brought to the Institute's attention with supporting evidence, the Institute will respond in writing. If an error exists, it will be noted on the Institute website and in all subsequent distribution of the publication, which constitutes the complete and final remedy under this guarantee.

ABOUT PRI

The Pacific Research Institute champions freedom, opportunity, and personal responsibility by advancing free-market policy solutions. It provides practical solutions for the policy issues that impact the daily lives of all Americans, and demonstrates why the free market is more effective than the government at providing the important results we all seek: good schools, quality health care, a clean environment, and a robust economy.

Founded in 1979 and based in San Francisco, PRI is a non-profit, non-partisan organization supported by private contributions. Its activities include publications, public events, media commentary, community leadership, legislative testimony, and academic outreach.

Education Studies
PRI works to restore to all parents the basic right to choose the best educational opportunities for their children. Through research and grassroots outreach, PRI promotes parental choice in education, high academic standards, teacher quality, charter schools, and school-finance reform.

Business and Economic Studies
PRI shows how the entrepreneurial spirit—the engine of economic growth and opportunity—is stifled by onerous taxes, regulations, and lawsuits. It advances policy reforms that promote a robust economy, consumer choice,
and innovation.

Health Care Studies
PRI proposes market-based reforms that would improve affordability, access, quality, and consumer choice. PRI also demonstrates why a single-payer, Canadian model would be detrimental to the health care of all Americans.

Technology Studies
PRI advances policies to defend individual liberty, foster high-tech growth and innovation, and limit regulation.

Environmental Studies
PRI reveals the dramatic and long-term trend toward a cleaner, healthier environment. It also examines and promotes the essential ingredients for abundant resources and environmental quality: property rights, markets, local action, and private initiative.

PACIFIC
RESEARCH
INSTITUTE

www.pacificresearch.org