EDUCATING, ENGAGING AND EMPOWERING CALIFORNIANS TO IMPROVE OUR STATE'S FUTURE

Energy Efficiency, Innovation and Job Creation in California

EXECUTIVE SUMMARY OCTOBER 2008

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NEXT 10

About Next 10

NEXT 10 IS A NONPARTISAN, NONPROFIT ORGANIZATION THAT EDUCATES, ENGAGES AND EMPOWERS CALIFORNIANS TO IMPROVE THE STATE'S FUTURE.

Next 10 is focused on innovation and the intersection between the economy, environment, and quality of life issues. We create tools and provide information that fosters a deeper understanding of the critical issues affecting our state. Through education and civic engagement, we hope Californians will become empowered to affect change.

Energy Efficiency, Innovation, and Job Creation in California is authored by Professor David Roland-Holst at the University of California Berkeley. Next 10 funds research from leading experts on complex state issues, providing critical data to help inform the state's efforts to grow the economy and reduce global warming emissions.

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Special thanks to Morrow Cater for providing the insight and guidance necessary to educate, engage, and empower Californians on these issues so critical to our future.

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Global climate change poses significant risks to the California economy. Recognizing and responding to these threats, Governor Schwarzenegger signed Executive Order #S-3-05 (Schwarzenegger 2005) which called for a 30 percent reduction below business as usual of greenhouse gas emissions by 2020 and 80 percent below 1990 levels by 2050. In September 2006, the California legislature passed and Governor Schwarzenegger signed into law the historic Global Warming Solutions Act (AB 32), which mandates a first-in-the-nation limit on emissions that cause global warming. In June 2006, the California Air Resources Board (CARB) released a "Draft Scoping Plan"—the policy roadmap to meet the emissions reduction target of 169 Million Metric Tons of Carbon (MMTCO2) equivalent by 2020 to stabilize at 427 MMTCO2 overall. CARB will take up final adoption of this plan in December 2008.

During the months leading up to this decision, a financial crisis of global proportions is unfolding. The state, nation and world are caught in serial market failures sparked by the collapse of the housing credit market, and there is much speculation about the impact of declining capital gains revenue on the state budget.

Against this backdrop, *Energy Efficiency, Innovation, and Job Creation in California* analyses the economic impact of CARB's past and future policies to reduce fossil fuel generated energy demand. California's achievements in energy efficiency over the last generation are well known, but evidence about their deeper economic implications remains weak. This study examines the economy-wide employment effects of the state's landmark efficiency policies over the last thirty-five years, and forecasts the economic effects of significantly more aggressive policies proposed to reduce emissions to 1990 levels by 2020.

Part I

ECONOMIC IMPACT OF CALIFORNIA'S EXISTING ENERGY EFFICIENCY POLICIES

Over the last thirty-five years, as a result of landmark energy efficiency policies, California has de-coupled from national trends of electricity demand, reducing its per capita requirements to 40 percent below the national average. Using detailed data on the changing economic structure over the period 1972–2006, we examine one of the most potent catalysts of efficiency-based economic growth, household reductions in per capita electricity demand. Because it represents over 70 percent of Gross State Product (GSP), household consumption is the most powerful driver of economic activity in the state, and household expenditure patterns are the leading determinant of state energy use.

METHODOLOGY

Producing detailed historical employment impact estimates involved a data intensive process including assembling a series of input-output tables, comprising inter-industry flows, value added, and final demand for about 500 activity and commodity categories over the period 1972–2006. The U.S. Bureau of Economic Analysis (BEA) maintains these accounts and updates them every five years. Each of the seven relevant national tables were obtained from BEA and aggregated up to the 50-sector framework reported in this paper. Also, comparable tables for California, estimated for 2002 and 2006, were aggregated to the same sector standard. In addition to data on economic structure for the last 35 years, detailed employment wage data were obtained by California Regional Economies Employment (CREE) Series. This source provides annual data on enterprises, jobs, and average wages for over 1,200 North American Industry Classification System (NAICS) sector categories across California.

To impute historical employment gains from California's energy efficiency measures, we pose a simple counterfactual question:

Given California's economic structure, how would employment growth have proceeded in the absence of household energy efficiency?

Answering this question requires three kinds of information:

1. Historical national and current California consumption patterns, which were obtained from BEA tables.
2. Historical economic structure for California, which is estimated using seven historical input-output tables for the national economy and one (2002) for California. In particular, we used a combination of national and state tables to approximate California's changing economic structure.
3. Employment by sector, which was provided by the CREE data set.

PART I CORE FINDINGS

- Energy efficiency measures have enabled California households to redirect their expenditure toward other goods and services, creating about 1.5 million FTE jobs with a total payroll of over $45 billion, driven by well-documented household energy savings of $56 billion from 1972-2006.
- As a result of energy efficiency, California reduced its energy import dependence and directed a greater percentage of its consumption to in-state, employment-intensive goods and services, whose supply chains also largely reside within the state, creating a "multiplier" effect of job generation.
- The same efficiency measures resulted in slower growth in energy supply chains, including oil, gas, and electric power. For every new job foregone in these sectors, however, more than 50 new jobs have been created across the state's diverse economy.
- Sectoral examination of these results indicates that job creation is in less energy intensive services and other categories, further compounding California's aggregate efficiency improvements and facilitating the economy's transition to a low carbon future.

Job Creation from Household Energy Efficiency									
	1972	**1977**	**1982**	**1987**	**1992**	**1997**	**2002**	**2007**	**Total**
Agriculture	—	36	112	204	266	631	849	869	2,967
EnergyRes	—	(0)	(1)	(1)	(0)	(1)	(1)	(1)	(5)
ElecPwr	—	(266)	(1,140)	(2,236)	(3,405)	(4,720)	(5,809)	(5,944)	(23,520)
OthUtl	—	(12)	(78)	(2)	13	71	77	79	149
Construction	—	—	—	—	—	—	—	—	—
Light Industr	—	821	2,688	4,593	6,095	8,392	9,247	9,463	41,300
OilRef	—	(14)	(6)	(9)	(10)	(14)	(24)	(25)	(102)
Chemica	—	48	190	448	764	555	2,234	2,287	6,526
Cement	—	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Metals	—	2	1	4	(5)	(16)	(16)	(16)	(46)
Machinery	—	14	26	54	44	(38)	(51)	(52)	(2)
Semicon	—	0	0	3	8	176	318	325	830
Vehicles	—	20	38	133	133	240	427	437	1,428
OthInd	—	37	125	265	397	1,136	1,770	1,811	5,541
WhlRetTr	—	4,740	15,254	32,236	46,139	83,118	136,402	139,587	457,475
VehSales	—	—	—	—	—	215	0	0	215
Transport	—	9	31	(211)	76	202	305	312	724
FinInsREst	—	1,191	5,340	15,075	30,808	21,500	34,201	35,000	143,114
OthPrServ	—	3,063	11,456	25,848	45,596	64,397	96,352	98,602	345,313
PubServ	—	74	3,360	22,488	56,060	98,866	148,691	152,163	481,703
TOTAL JOBS	**—**	**9,763**	**37,396**	**98,892**	**182,977**	**274,710**	**424,974**	**434,898**	**1,463,611**

Employee Compensation Gains from Household Energy Efficiency (millions of 2000 US dollars)									
	1972	**1977**	**1982**	**1987**	**1992**	**1997**	**2002**	**2007**	**Total**
Agriculture	—	0	2	3	4	9	16	17	52
EnergyRes	—	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
ElectPwr	—	(10)	(50)	(111)	(190)	(303)	(441)	(546)	(1,652)
OthUtl	—	(1)	(4)	(0)	0	4	5	6	10
Construction	—	—	—	—	—	—	—	—	—
LightIndustr	—	20	70	117	162	214	284	323	1,190
OilRef	—	(1)	(0)	(0)	(1)	(1)	(2)	(3)	(8)
Chemica	—	2	7	16	27	23	87	97	258
Cement	—	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Metals	—	0	0	0	(0)	(1)	(1)	(1)	(2)
Machinery	—	0	1	2	2	(1)	(2)	(2)	(2)
Semicon	—	0	0	0	0	11	25	32	69
Vehicles	—	1	2	7	7	11	22	22	72
OthInd	—	1	3	7	12	36	67	82	208
WhlRetTr	—	105	336	707	1,026	1,859	3,530	3,647	11,211
VehSales	—	—	—	—	—	7	0	0	7
Transport	—	0	1	(8)	3	8	14	13	32
FinInsREst	—	31	158	512	1,207	971	2,036	2,415	7,329
OthPrServ	—	76	209	438	824	1,356	2,440	2,679	8,022
PubServ	—	2	107	730	1,866	3,160	5,526	6,422	17,814
TOTAL PAYROLL	**—**	**$227**	**$840**	**$2,420**	**$4,950**	**$7,363**	**$13,605**	**$15,205**	**$44,611**

Source: Author's estimates.

Part II

FUTURE ECONOMIC IMPACTS OF CALIFORNIA'S PROPOSED POLICIES

At this critical moment of economic distress, balanced policy dialogue requires a more complete assessment of both the potential benefits and costs of the options before the state. Because of its pioneering role in climate policy, California faces a significant degree of uncertainty about direct and indirect effects of the many possible approaches to its stated goals for emissions reduction. High standards for economic analysis are needed to anticipate the opportunities and adjustment challenges that lie ahead and to design the right policies to meet them. Progress in this area can increase the likelihood of two essential results: that California policies work effectively and that they achieve the right balance between public and private interest.

In this part of the analysis, we conduct a rigorous ex ante economic assessment of draft policies contained in the California Air Resources Board Draft Scoping Plan.

Impact of Technological Change and Innovation

An important limitation of most prior California economic modeling of climate policies is innovation or technological neutrality. This means that factor productivity, energy use intensities, and other innovation characteristics were held constant across policy scenarios. Energy use and pollution levels might change, but the prospect of innovation to reduce energy intensity was not considered.

Inclusion of innovation is important for two reasons. Technological change in favor of energy efficiency has been a hallmark of California's economic growth experience over the last four decades. As the earlier estimates show, the resultant energy savings have been an important growth and employment stimulus to the state economy. Moreover, most observers credit this technological progress to California's energy/climate policy combinations of mandates and incentives. And as discussed in Part I, California has reduced its aggregate energy intensity steadily over this period, attaining levels that today are 40 percent below the national average. Importantly, reductions in energy use were not flat across the last thirty-five years; instead energy efficiency grew at exponential rates.

In the present analysis, we factor in the prospect of innovation to reduce energy intensity by projecting a rate of energy efficiency gains that better reflect historical achievements, as well as the impact of significantly more aggressive policies aimed to reduce energy use. It is reasonable to assume that new climate polices will create new incentives for innovation. This is particularly true for policies like "Cap and Trade" which is included in the state's Draft Scoping Plan and will put an explicit price on carbon externalities that did not exist before. When firms are faced with new costs from emissions and energy use, they can be expected to make investments in technology that reduces these costs.

To capture this innovation, we assume that, subject to the implementation of the recommended measures, California is able to increase its energy efficiency by one additional percent per year, on an average basis, across the economy. This conservative estimate may be below the state's innovation potential in such circumstances, given that much lower energy prices and less determined policies were in place for the long period of improvement before AB 32.

Recently, the Center for Energy, Resources, and Economic Sustainability (CERES) at the University of California Berkeley conducted scenario analysis for the California Air Resources Board, which is included as supplement to their economic forecasts conducted using the E-DRAM model. While the policy scenario analyzed here is identical to that modeled for the state, this analysis includes the potential for innovation to reduce energy intensity. The state's official modeling assumes technology characteristics remain static and includes a flat rate of energy efficiency for the time period considered (2008–2020).

METHODOLOGY

For the last three years, CERES has been conducting independent research to inform public and private dialogue surrounding California climate policy. Among these efforts has been the development and implementation of a statewide economic model, the Berkeley Energy and Resources (BEAR) model, the most detailed and comprehensive forecasting tool of its kind.

The BEAR model's sectoral detail, model determined emissions, and dynamic innovation and forecasting capabilities enable it to capture a wide range of program characteristics and their role in economic adjustments to climate action. BEAR was designed to model cap and trade systems, and includes all the major design features such as variable auction allocation systems, market determined permit prices, banking options, safety valves, and fee/rebate systems for CO2 and up to thirteen other criteria pollutants. BEAR is a detailed, computable general equilibrium model of California's economy that simulates demand and supply relationships across many sectors of the economy, and tracks the linkages among them. It can thus be used to trace the ripple effects throughout the economy over time of new economic and technology policies.

To assess the future economic impacts of the state's package of proposed policies to reduce greenhouse gas emissions, we used BEAR to model a generic policy scenario, which faithfully represents policies currently in the CARB Draft Scoping Plan.

PART II CORE FINDINGS

- By including the potential for innovation, we find that the proposed package of policies in the state's Draft Scoping Plan achieves 100 percent of the greenhouse gas emissions reduction targets as mandated by AB 32 while increasing the Gross State Product (GSP) by about $76 billion, increasing real household incomes by up to $48 billion and creating as many as 403,000 new efficiency and climate action driven jobs.
- The economic benefits of energy efficiency innovation have a compounding effect. The first 1.4 percent of annual efficiency gain produced about 181,000 additional jobs, while an additional one percent yielded 268,000 more. It is reasonable to assume that the marginal efficiency gains will be more costly, but they have more intensive economic growth benefits.
- Existing energy efficiency programs and proposed state climate policies will continue the structural shift in California's economy from carbon intensive industries to more job intensive industries. While job growth continues to be positive in the carbon fuel supply chain, it is less than it would be without implementation of these policies.

SUMMARY

California's legacy of energy policies and resulting economic growth provides evidence that innovation and energy efficiency can make essential contributions to economic growth and stability. Had the state not embarked on its ambitious path to reduce emissions over three decades ago, the California economy would be in a significantly more vulnerable position today.

Looking ahead, California's ambitious plan to reduce greenhouse gas emissions as mandated by the California Global Warming Solutions Act (AB 32) puts the state on a more stable economic path by encouraging even greater investment in energy saving innovation.

The current financial crisis reminds us of the importance of responsible risk management. The results of this study remind us that, in addition to energy price vulnerability and climate damage, the risks of excessive energy dependence include lower long-term economic growth. A lower carbon future for California is a more prosperous and sustainable future.

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