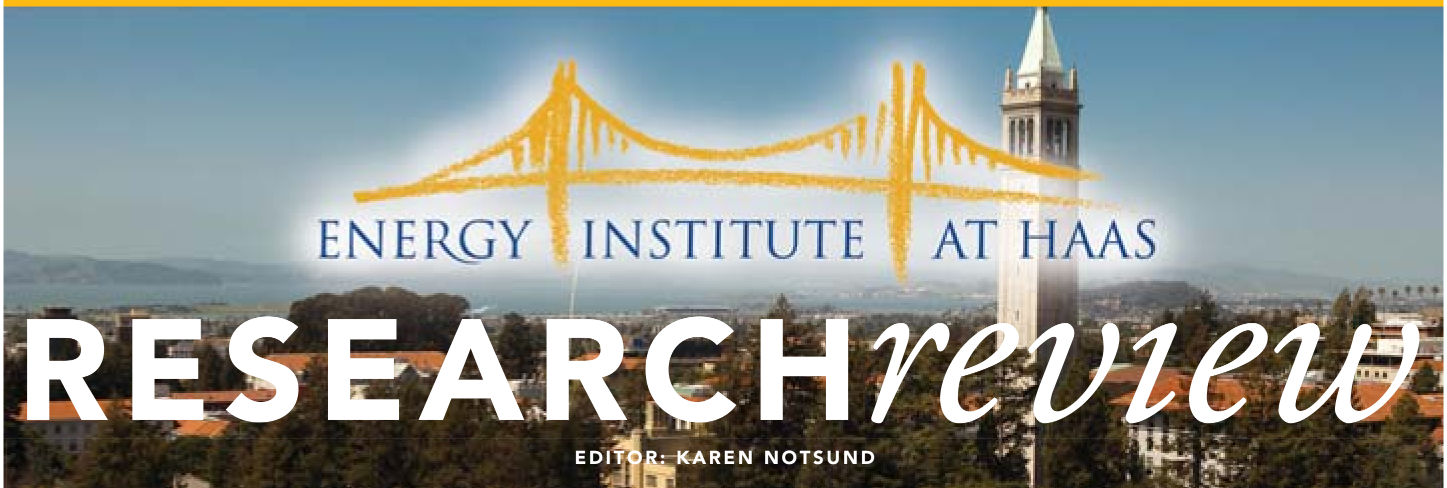
SPRING 2011



Electricity Prices and Conservation: Do Current Policies Reduce Consumption?

A major policy objective of California's residential electricity pricing schedules is to promote energy conservation. Since 2001, the three California investor-owned utilities have had increasing block pricing for residential electricity, which means that as a household uses more electricity over the month the price of electricity increases. Theoretically, this should motivate households to use less electricity. But are consumers even aware of the price they pay for electricity? If they are aware, does this pricing scheme accomplish its goal of reducing electricity consumption?

IN THIS ISSUE

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A fundamental tenet of economics is that consumers respond to the marginal price of a good or service. California's residential electricity pricing schedule is built upon this assumption. In EI @ Haas Working Paper WP-210, **Koichiro Ito** (University of California, Berkeley, Ph.D. Candidate in Agricultural & Resource Economics) analyzes whether households actually do respond to their marginal price. Ito finds that they don't. Instead, households seem to respond to the *average* price they face.

Ito's pathbreaking paper, "Do Consumers Respond to Marginal or Average Price? Evidence from Nonlinear Electricity Pricing," analyzes the electricity consumption patterns of nearly identical households that face very different pricing schedules. His analysis relies on a data set of household-level monthly electricity billing records for nearly all households on either side of a service area border of two electric utilities: Southern California Edison (SCE) and San Diego Gas and Electric (SDG&E). The service area border lies within the city boundaries of six cities. Figure 1 shows the territory border of the two utilities and the city boundaries in Orange County. As a result, different households in the same city are served by different electric utilities. Ito specifically focuses on households located within one mile of the utility border resulting in a data set of households that are nearly identical in their demographics, housing characteristics, and weather conditions. However, households in one utility service territory experience substantially different electricity price schedules than the households in the other utility service area because the two utilities set their price schedules independently.

In 1999 and early 2000, SCE and SDG&E had nearly the same two-tier increasing-block price schedules with only slightly higher prices for SCE customers. The first price shock occurred during the California electricity

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Cap-and-Trade: Who Pays For the Free Permits?

Adoption of a cap-and-trade program limiting domestic greenhouse gas emissions could place some industrial producers at a disadvantage relative to competitors who do not face similar regulations. Even if the entire U.S. were to adopt a federal cap-and-trade program, domestic producers who face competition from foreign producers who do not face similar regulations in their home countries could be at a cost disadvantage.

In efforts to reach a political consensus on cap-and-trade programs, proposed climate legislation at the state and federal level includes provisions designed to "level the carbon playing field." One such provision would allocate free emissions allowances to eligible industries using a continuously updating output-based formula. In the proposed Waxman-Markey climate change legislation, these free permit allocations were designed to completely offset both direct and indirect compliance costs to those industries most affected.[1]

While the potential benefits of contingent allocation updating have been well documented, there have been few, if any, attempts to estimate the costs. **Meredith Fowlie** (University of California, Berkeley) investigates both the benefits and costs of output-based updating in her paper "Updating the Allocation of Greenhouse Gas Emissions Permits in a Federal Cap-and-Trade Program" (EI @ Haas Working Paper #207).

Historically, policy makers have chosen between two types of permit allocation approaches: auctioning and grandfathering. Under an auction regime, emissions permits are sold to the highest bidder. In contrast, "grandfathered" permits are freely distributed in lump-sum to regulated sources based on pre-determined, firm-specific characteristics. Economists have generally argued in favor of auctioning permits when auction revenues can be used to offset other pre-existing distortions elsewhere in the economy (such as taxes on factors of production). In practice, however, policy makers have routinely chosen to forego auction revenues in favor of handing permits out for free to regulated entities. The ability to make concessions to adversely impacted and politically powerful stakeholders via grandfathering has played an essential role in securing widespread support for the adoption of emissions trading programs.

A pure grandfathering approach is unlikely to be a politically feasible option in the context of a federal emissions trading program, primarily due to the unprecedented value of permits to be allocated and the implication that those industries would not have to reduce their emissions. In such a politically charged climate, "output-based updating" of permit allocations has emerged as something of a Goldilocks solution. In an output-based updating allocation scheme the number of permits a firm receives at no cost increases with its output. Proposed output-based updating provisions have been designed to offset the average effect that emissions regulation would otherwise have on producers' operating costs. Industry is compensated – but not over compensated – for the compliance costs incurred.

The potential benefits of these proposed allocation provisions, including the mitigation of emissions leakage and the moderation of adverse competitiveness impacts, have been well documented. The costs of such an allocation scheme have not been so discussed. When output-based rebates are offered to a subset of the sources in an emissions trading program, this reduces the costs of compliance for the eligible industries. Increased production (and emissions) in these eligible industries shifts more of the compliance burden to sources covered under the cap, but not eligible for the rebates. Thus, a greater share of the mandated emissions reductions must then be achieved by sources excluded from rebating provisions. Output based updating can also mitigate the extent to which emissions prices are reflected in consumer prices, thus dampening (or eliminating) incentives for consumers to reduce their consumption of goods produced by industries receiving the rebates. Contingent allocation updating therefore introduces important trade-offs between reducing the compliance burden for a specific sector and minimizing the overall economic cost of achieving the mandated emissions reductions.

Among the most fundamental questions in the design of cost mitigation measures is: Who should be eligible for this assistance? In the Waxman-Markey legislation, the industries eligible for the free permits were those considered most exposed to foreign competition and/or industries that were deemed "energy-intensive." In her paper, Fowlie derives eligibility criteria that would be used by a policy maker seeking to maximize benefits to society as a whole. In comparing Fowlie's derived thresholds for allocating permits to the thresholds proposed under federal legislation, Fowlie finds that the relationship between emissions intensity and eligibility status is reversed.

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1 This bill, approved by the House of Representatives in June 2009, would have established a federal carbon emissions trading program. The bill died in the Senate.

Regulation and Employment Decisions: Where do Manufacturing Firms Locate?

Regulations, it is often argued, stifle job growth through increasing the cost of doing business. Manufacturing jobs, in particular, are said to look for cheap land, low wages, lax regulatory requirements and cheap energy to keep their production costs low. However not all manufacturing industries require the same inputs and when faced with the decision of where to locate can face several tradeoffs. This leads to different manufacturing industries having different rankings of the desirability of the same set of geographical areas. So does regulation inhibit job growth in an area? The answer, according to this new study, is it depends.

Manufacturing industries differ with respect to their energy intensity, labor-to-capital ratio and pollution intensity. Across the United States there is significant variation in electricity prices, and labor and environmental regulation. **Matthew E. Kahn** (University of California, Los Angeles) and **Erin Mansur** (Dartmouth College) in their paper, "How Do Energy Prices, Labor and Environmental Regulations Affect Local Manufacturing Employment Dynamics? A Regression Discontinuity Approach" (EI @ Haas Working Paper #209) study where different manufacturing industries choose to locate.

Kahn and Mansur cluster manufacturing into 21 industries based on their labor-to-capital ratio, energy consumption per unit of output, and pollution intensity. The authors then identify counties based on their average industrial electricity price, the state's labor regulation and the county's Clean Air Act regulatory status. A county's labor regulation designation is determined by whether the state has adopted a Right-to-Work law. A Right-to-Work state secures the right of employees to decide for themselves whether or not to join or financially support a union. A county's environmental regulatory status is determined by whether the county is in attainment or non-attainment status under the Clean Air Act. The authors restrict their comparison to pairs of counties where there are differences in at least one of these three attributes. They limit their study to the 781 counties that lie within metropolitan areas. More than 75% of the nation's jobs are located in these counties. They then compare employment counts by manufacturing industries in adjacent counties. Adjacent counties share many common factors such as amenities and common local labor market and similar access to final consumers but two adjacent counties can differ along key dimensions such as energy prices and exposure to government labor and environmental policy. Kahn and Mansur exploit this within county-pair variation in energy prices and labor and environmental regulation to provide new estimates of their effects on where manufacturing industries decide to locate.

Using U.S. County Business Patterns data from 1998 through 2006, Kahn and Mansur find that energy-intensive industries concentrate in low electricity price counties, labor-intensive industries avoid pro-union counties, and pollution-intensive industries locate in counties featuring relatively lax Clean Air Act regulation, i.e., attainment counties.

The researchers test the relative sensitivities of a given industry's location decisions to energy prices, labor policy and environmental policies. For an industry like primary metals – which is energy intensive, capital intensive and a high particulate matter polluter – banning Right-to-Work laws would have the same effect on employment as a 3.8 percent increase in electricity prices. In contrast, if a primary metal manufacturer's county falls into non-attainment status and is thereby subject to more stringent environmental regulations, this is akin to increasing electricity prices by 34 percent. For other industries that are less energy intensive but still polluting, like wood products, labor and environmental regulations are much more costly relative to energy prices: these policies would reduce employment to the same degree as increasing electricity prices 118 and 256 percent, respectively. Other industries that are not energy or pollution intensive are not negatively affected by either higher energy prices or pollution requirements. Based on their findings, Kahn and Mansur conclude that energy prices are only a significant determinant of locational choice for a handful of manufacturing industries, such as primary metals. For the typical manufacturing industry, the electricity price effects are modest.

When Kahn and Mansur simultaneously study the role of labor regulation and electricity prices, their results indicate that both the absolute magnitude of the electricity price effects and the labor regulation effects are smaller when they study them separately versus jointly. These results highlight the importance of simultaneously studying all of the impacts within a unified framework.

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ELECTRICITY PRICES AND CONSERVATION: DO CURRENT POLICIES REDUCE CONSUMPTION?

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crisis in the summer of 2000. By August 2000, SDG&E's rates had increased 100% relative to 1999 due to increases in the price of wholesale electricity. SCE's residential rates, however, did not change during this time because SCE's retail prices were still frozen as part of the deregulation transition process. In 2001, at different points, each of the utilities replaced their two-tier rate schedule with five-tier price schedules. The two utilities changed their tiered rates differently over time and the magnitude of the variation between the utilities' rates was substantial. Figure 2 displays the price changes for SCE and SDG&E over the period 1999 to 2009. This resulted in households on either side of the utility border facing substantially different tier rates.

Key to discerning whether households respond to marginal or average price is the fact that the difference in marginal prices on either side of the utility border is often significantly different from the difference in average prices. Figure 3, for example, shows the marginal and average price in August 2002. For customers on the third tier, the marginal price is essentially the same at both utilities. The average price, however, is higher for SDG&E customers. Similarly, consider customers on the fourth tier. The marginal price is higher for SCE customers, whereas the average price is higher for SDG&E customers. The price variation helps identify whether households respond to marginal or average price.

If consumers were responding to their marginal price, standard economic theory would predict that there would be bunching around the price steps, i.e., consumers would stop consuming just at the point where the marginal price increases.

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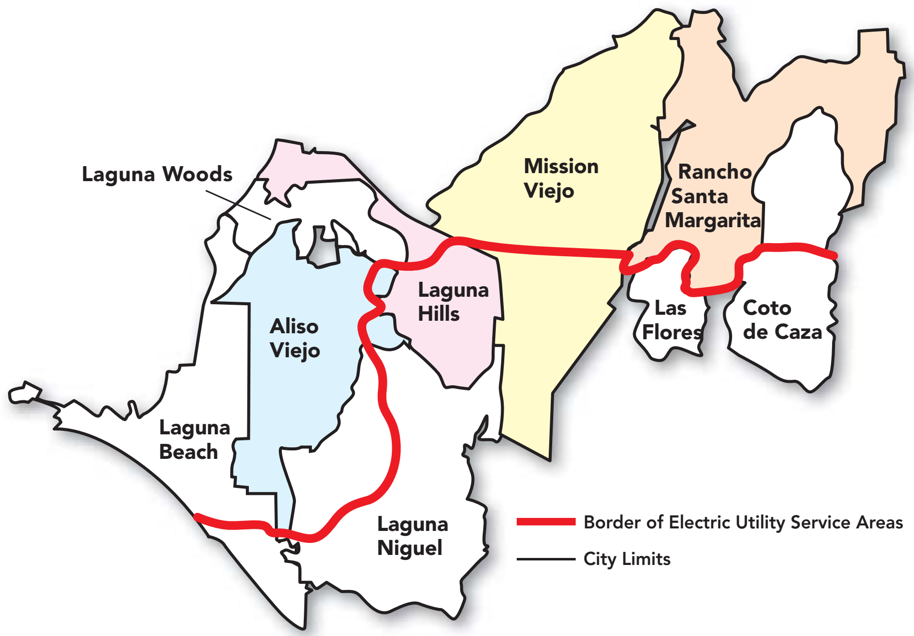
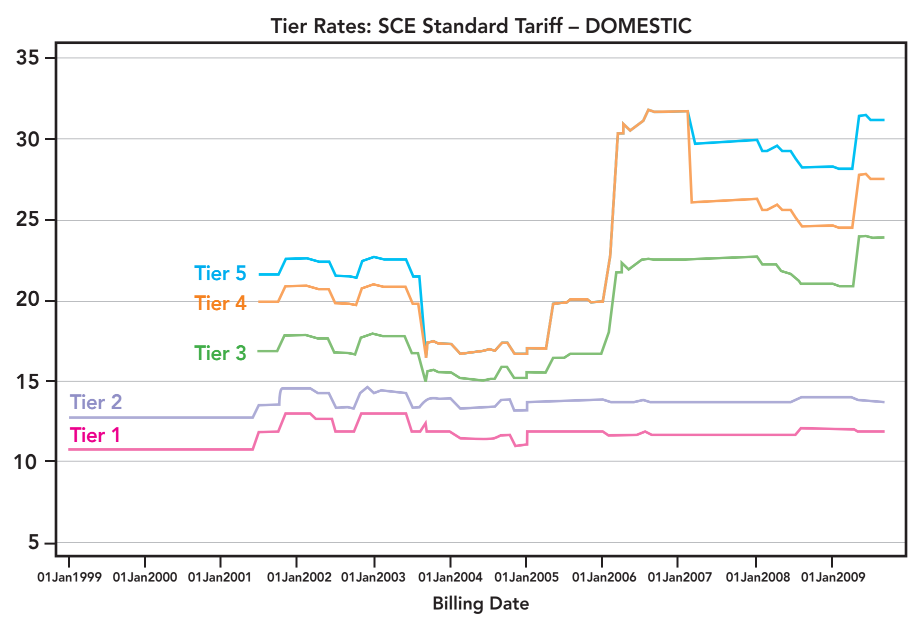
FIGURE 1: CITY BOUNDARIES AND ELECTRIC UTILITY SERVICE AREA BORDERS IN ORANGE COUNTY, CALIFORNIA



Notes: The bold line shows the service area border of Southern California Edison and San Diego Gas & Electric. SCE provides electricity for the north side of the border and SDG&E covers the south side. The map also presents city limits. The utility border exists inside the city limits in Laguna Beach, Laguna Niguel, Aliso Viejo, Laguna Hills, Mission Viejo, and Coto de Caza.

FIGURE 2: TIER RATES FOR STANDARD PRICE SCHEDULES FROM 1999 TO 2009



ELECTRICITY PRICES AND CONSERVATION: DO CURRENT POLICIES REDUCE CONSUMPTION?

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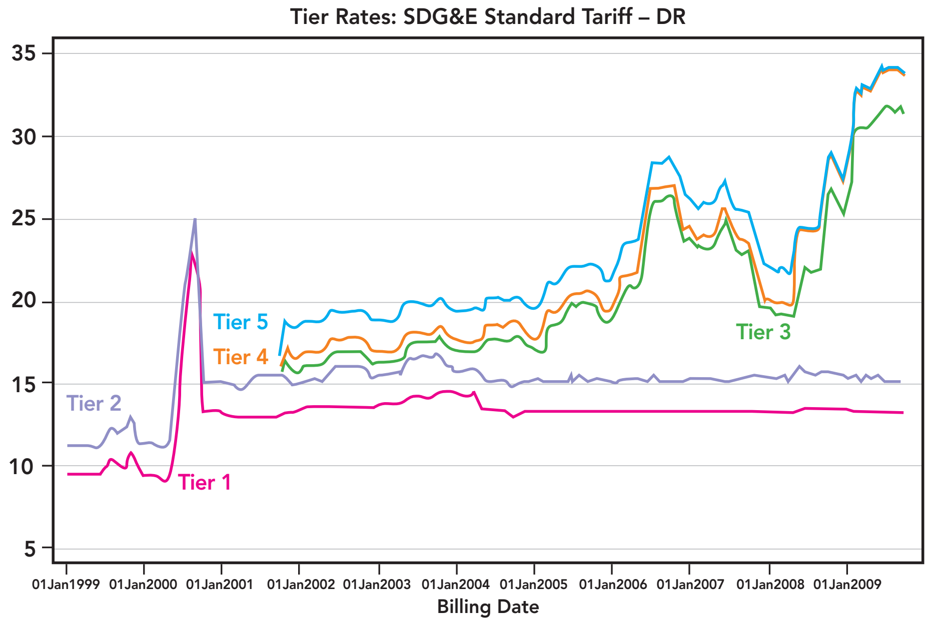
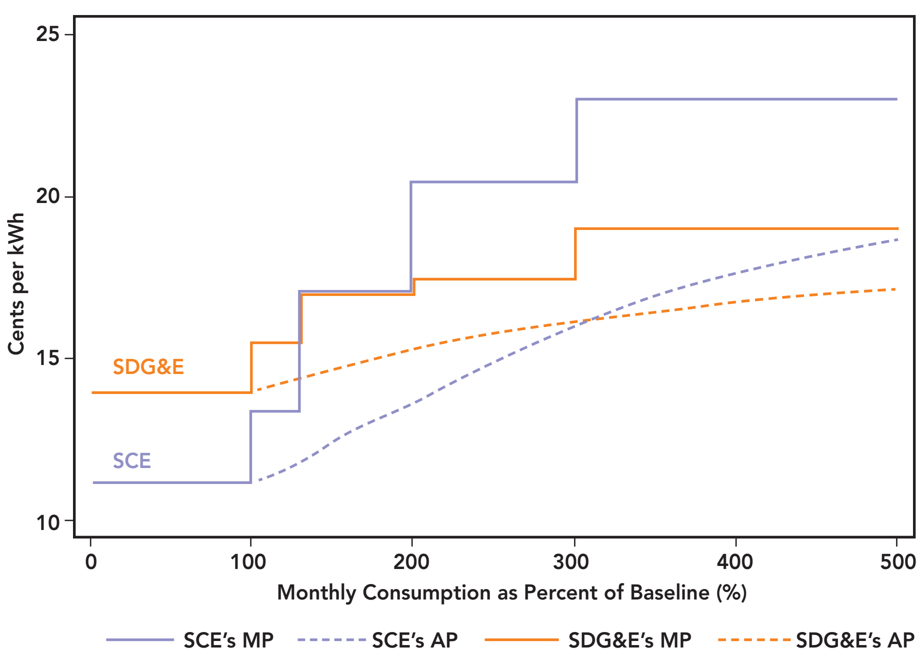
FIGURE 2: TIER RATES FOR STANDARD PRICE SCHEDULES FROM 1999 TO 2009 (CON'T)



Notes: The figures display how residential electricity prices changed over time in SCE and SDG&E. Each of the five tier rates corresponds to the tier rates in the five-tier increasing block price schedules. The third, fourth, and fifth tiers did not exist before 2001. The fifth tier did not exist between 2004 and 2006 in SCE, and after 2008 in SDG&E.

FIGURE 3: STANDARD RESIDENTIAL ELECTRICITY PRICE SCHEDULES IN SCE AND SDG&E IN AUGUST 2002



Notes: The figure presents five-tier increasing block price schedules in SCE and SDG&E. About 80% of their customers are on these standard price schedules. The price of 1 kWh is a step function of monthly consumption as a percent of the baseline that is assigned by the utilities. The marginal price equals the first tier rate up to 100% of the baseline, the second tier rate up to 130%, the third tier rate up to 200%, the fourth tier rate up to 300%, and the fifth tier rate over 300% of the baseline. The figure shows the price schedules in August 2002 as an example. The utilities change the tier rates frequently.

Ito finds no evidence of bunching and instead notes a smooth distribution of monthly consumption for each of the utilities. The absence of bunching could be explained by two possible reasons. No bunching may imply that consumers have nearly zero price elasticity for electricity demand, meaning they do not respond to changes in price, or that consumers may respond to other perceptions of price, such as average price.

Price variation occurs differently across the five tiers for each of the utilities. As a result, lower electricity users and higher electricity users experience different changes in price. Ito examines the change in price and consumption separately for each decile of the electricity consumption distribution. The top decile (i.e., the largest electricity consumers) in the two utilities experienced substantially different changes in marginal and average price after 2001. In 2001, SDG&E's marginal and average prices increased about 30% more than SCE's for people in that top decile. Importantly, the relative change in marginal price and the relative change in average price were quite different in 2002, 2003, 2007 and 2008. In those years, SDG&E's

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REGULATION AND EMPLOYMENT DECISIONS: WHERE DO MANUFACTURING FIRMS LOCATE?

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The take-away theme here is one of comparative advantage. The most energy-intensive industries respond to electricity prices, the most labor-intensive industries respond to labor regulation, and the most pollution-intensive industries respond to environmental regulatory differences.

TABLE 1: SIMULATION OF CARBON POLICY ($15/ton of CO_2) BY STATE

State	Change in Employment	Percent Change	Average Electricity Index	Change in Electricity Price
Ohio	-11,864	-2.2%	26.9%	$0.013
Pennsylvania	-10,103	-2.0%	28.7%	$0.010
North Carolina	-7,189	-2.6%	26.2%	$0.009
Michigan	-7,080	-1.5%	21.0%	$0.013
Indiana	-6,030	-2.0%	27.8%	$0.013
Wisconsin	-5,541	-1.8%	27.8%	$0.012
Texas	-5,213	-0.8%	21.5%	$0.009
Illinois	-4,877	-0.9%	26.2%	$0.012
New York	-4,752	-1.1%	22.5%	$0.011
New Jersey	-4,355	-1.5%	27.4%	$0.009
Tennessee	-4,202	-2.5%	25.5%	$0.010
Missouri	-4,133	-2.3%	22.3%	$0.011
South Carolina	-3,544	-2.4%	29.6%	$0.009
Georgia	-3,387	-2.1%	28.6%	$0.009
Alabama	-3,083	-2.3%	26.8%	$0.009
Minnesota	-2,877	-1.4%	20.3%	$0.012
Florida	-2,725	-1.0%	20.0%	$0.009
Massachusetts	-2,293	-0.9%	22.4%	$0.011
California	-2,016	-0.1%	19.1%	$0.004
Washington	-1,411	-0.7%	19.5%	$0.004
Kentucky	-1,321	-1.4%	27.2%	$0.013
Maryland	-1,219	-1.3%	22.2%	$0.011
Colorado	-1,091	-1.1%	20.8%	$0.004
Connecticut	-1,026	-0.7%	19.0%	$0.011
Arkansas	-951	-1.5%	24.1%	$0.009
Oregon	-938	-0.7%	21.6%	$0.004
Nebraska	-828	-2.4%	24.4%	$0.012
Oklahoma	-528	-0.7%	22.9%	$0.010
Kansas	-467	-0.5%	18.0%	$0.010
New Hampshire	-464	-1.1%	19.0%	$0.011
Utah	-459	-0.6%	18.5%	$0.004
South Dakota	-423	-3.2%	20.0%	$0.009
Rhode Island	-399	-0.9%	24.7%	$0.011
Mississippi	-350	-1.8%	30.8%	$0.009
Arizona	-219	-0.2%	21.0%	$0.004
Maine	-193	-1.2%	28.4%	$0.009
Nevada	-164	-0.5%	24.9%	$0.004
Louisiana	-160	-0.2%	24.2%	$0.009
Delaware	-137	-1.3%	33.3%	$0.009
New Mexico	-88	-0.5%	16.4%	$0.004
Idaho	-49	-0.7%	21.1%	$0.004
Wyoming	-2	-0.1%	19.2%	$0.004
District of Columbia	0	0.0%	19.1%	$0.009
Montana	12	0.3%	22.8%	$0.004
Vermont	201	3.4%	16.5%	$0.011
Iowa	288	0.4%	24.2%	$0.012
North Dakota	338	3.6%	20.8%	$0.012
West Virginia	1,735	19.6%	43.0%	$0.013
Virginia	2,396	2.9%	23.8%	$0.010

Kahn and Mansur use their estimates of the relationship between local manufacturing employment and local electricity prices to simulate the consequences of a new local carbon mitigation policy such as a carbon tax. Since the expectations of a federal carbon policy are low, they look at the impacts of a carbon policy within regional electricity markets. They ask: what is the impact on employment of a carbon policy that induces a price of $15 per ton of carbon dioxide? Based on their estimates for the year 2006, they predict that the introduction of a $15 per ton cap-and-trade program in California under AB32 would lead to a loss of two thousand jobs for this state (a .1% reduction). If a $15 per ton carbon dioxide policy were adopted in the Northeastern states that comprise the Regional Greenhouse Gas Initiative (RGGI) region, then they predict a loss of fifteen thousand jobs in that region (a 1.1% reduction). RGGI region's greater percentage differential is due to the fact that this region's electric utilities have a higher carbon emissions factor and its industries are on average more energy intensive than California's. Table 1 provides the estimates of the impact of a $15 carbon tax on each state.

Regulation and high energy prices do have an impact on job creation but it's not a uniform impact. Depending on the industry's production costs and pollution profile, certain regulations may have little or no impact on a firm's decision on where to locate.

Matthew E. Kahn and Erin T. Mansur, "How Do Energy Prices, and Labor and Environmental Regulations Affect Local Manufacturing Employment Dynamics? A Regression Discontinuity Approach," EI @ Haas WP-209, November 2010.

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ELECTRICITY PRICES AND CONSERVATION: DO CURRENT POLICIES REDUCE CONSUMPTION?

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marginal price decreased more than SCE's marginal price for its customers in the top tiers, but SDG&E's average price increased more than SCE's average price. Therefore, if consumers respond to marginal price, SDG&E's consumption should have increased more than SCE's in those years. But it did not. Instead, Ito found that when marginal and average price change in opposite directions, consumption moved in response to average price. This result holds true for the other deciles of consumption as well.
The results are supported by Ito's econometric analysis, which indicates that only average price has a statistically significant impact on electricity consumption.

Why do consumers respond to average price rather than marginal price? Given the current technology and time available to most consumers, the information cost required to react to their marginal price is likely to be higher than the utility gain. For example, Ito shows that even with one of the steepest nonlinear price schedules during this period, consumers can save less than $2 per month on average by re-optimizing consumption with respect to marginal price rather than average price. This savings is likely to be less than the information cost for most consumers for two reasons. First, it is not straightforward for most consumers to monitor their cumulative electricity consumption during their billing cycle without having special home devices inside their houses. Second, the design of bills in most electric utilities generally makes it hard to discern the consumer's true marginal price.

To investigate the claim that the five-tier increasing block pricing structure leads to a reduction in electricity consumption, Ito compares consumption under the five-tier tariff structure with estimated consumption under an alternative flat rate tariff. He calculates a flat rate tariff which produces the same profit as the existing five-tier tariff. Contrary to the policy objective, the observed consumption under the existing five-tier tariff is 0.54% *higher* than the simulated consumption under the flat rate tariff.

Ito's findings suggest that California residential electricity consumers are responding to their average rather than their marginal price. The net effect of increasing-block pricing on residential electricity consumption is probably quite small and may actually yield a slight increase in consumption.

Koichiro Ito, "Do Consumers Respond to Marginal or Average Price? Evidence from Nonlinear Electricity Pricing," EI @ Haas WP-210, November 2010.

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CAP-AND-TRADE: WHO PAYS FOR THE FREE PERMITS?

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Under proposed allocation designs, the most emissions intensive industries are presumptively eligible for output-based compensation, yet in Fowlie's optimal scenario, industries with high emissions intensities are not eligible for free permits because the benefits accruing to the industry receiving them are smaller than the costs to the economy as a whole. Fowlie is quick to issue a caveat with these results. Her analysis assumes away political constraints, which clearly are an unavoidable factor in the case of climate change policy.

Output-based allocation of free permits offers a politically palatable means of redistributing surplus from foreign firms and less energy-intensive domestic firms to a minority of industries that would expect to experience significant adverse impacts under a federal emissions program. A politically viable climate policy regime will need to shelter these politically powerful industries from adverse impacts. This paper draws attention to the costs incurred when output-based rebates are chosen as the vehicle for transferring surplus to these important industries.

Meredith Fowlie, "Updating the Allocation of Greenhouse Gas Emissions Permits in a Federal Cap-and-Trade Program," EI @ Haas WP-207, June 2010.

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