U.S. Experience with ETS Benchmarking: The case of California (A.B. 32)

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Resources for the Future

KEI Workshop: Experience with Emission Benchmarks – Options for International Coordination

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Topics

- Background
- The California approach
- New research

Background

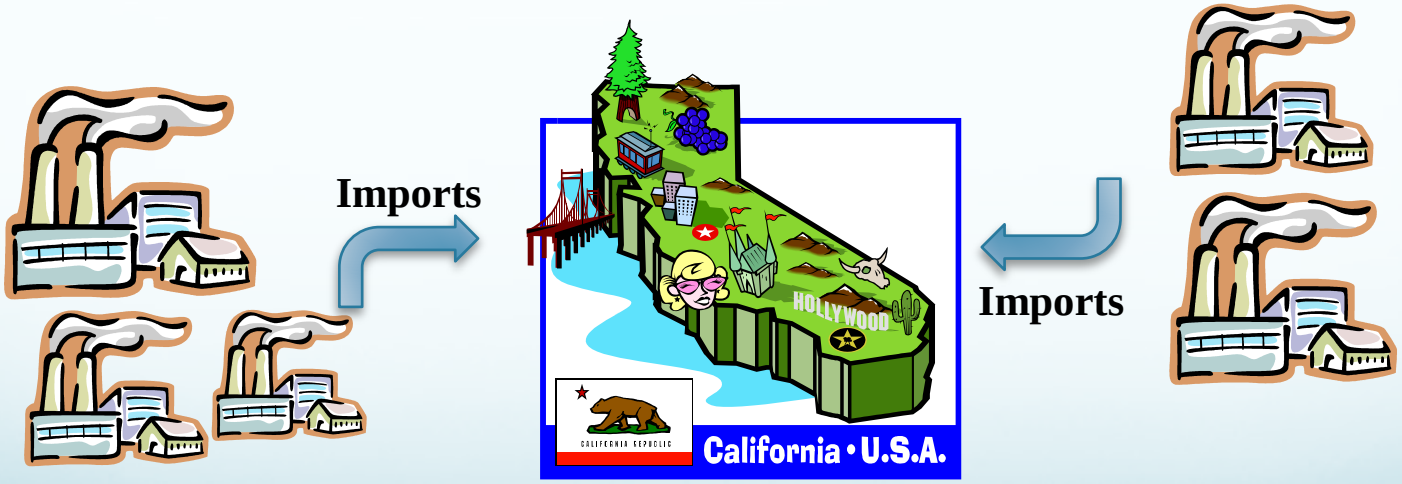
- Carbon pricing will increase the cost of using energy
  - Potentially adverse effects on prices, sales, profits, output, and employment in EITE industries
  - Output based rebates (free allocation) can offset some or all impacts, possibly overcompensate
- How big are impacts?
  - Interested parties likely to make conflicting claims
  - Limited data will be available in real time, although allowance and energy prices are readily observed
  - Economic models can provide estimates of likely consequences of a given carbon price

Output Based Rebates

- A.B. 32 authorized limited use of freely allocated rebates for CA energy intensive industries facing out of state competition
- Key is that rebates tied to firms' CA production, and updated periodically
- Reduce competitiveness impacts while keeping incentives to cut carbon intensity
- Challenge: to determine how much free allocation is really needed to achieve goals

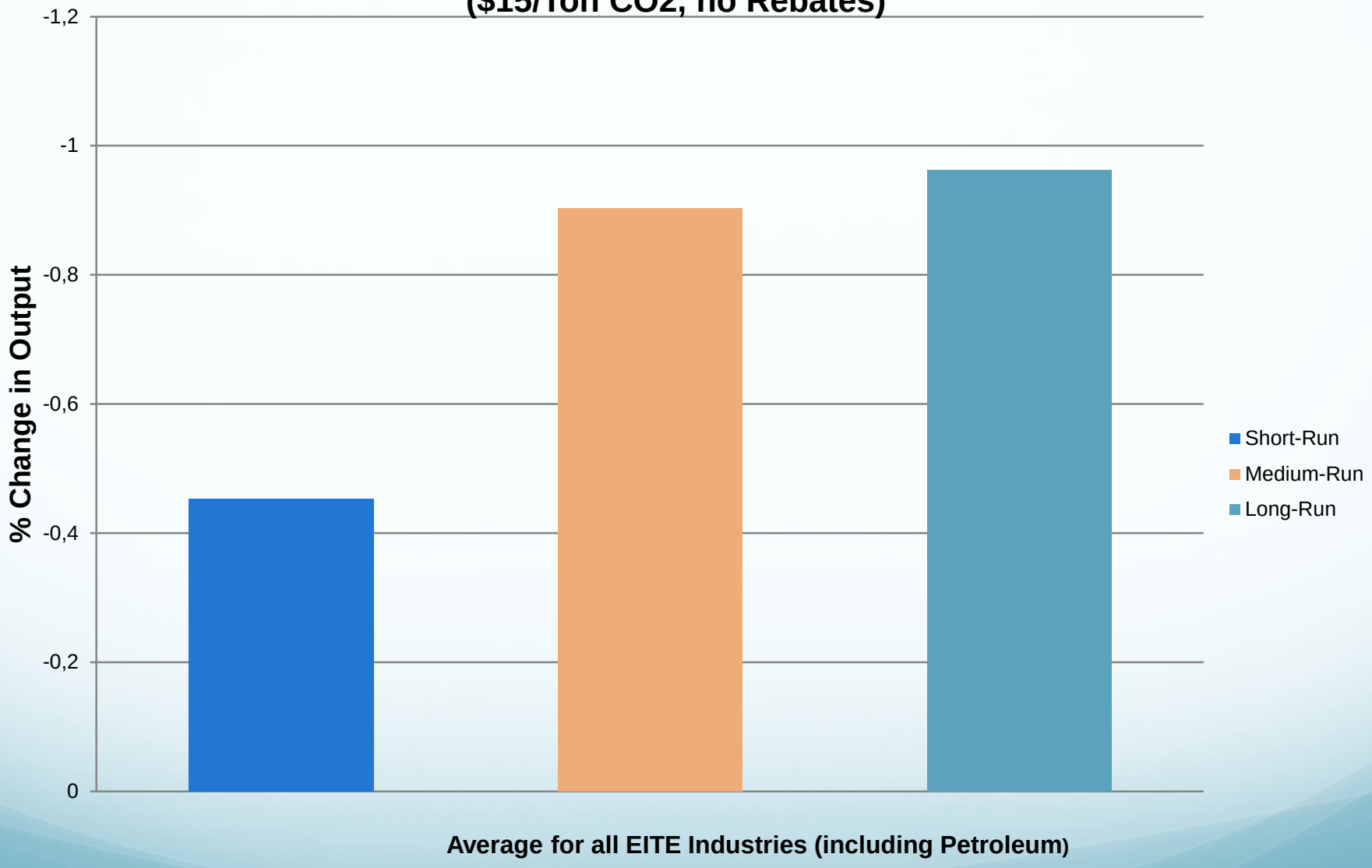
Who is at Risk for Leakage?

- Industries in which production is highly emissions intensive, leading to high compliance costs
- Industries in which competition is strong from out-of-State producers



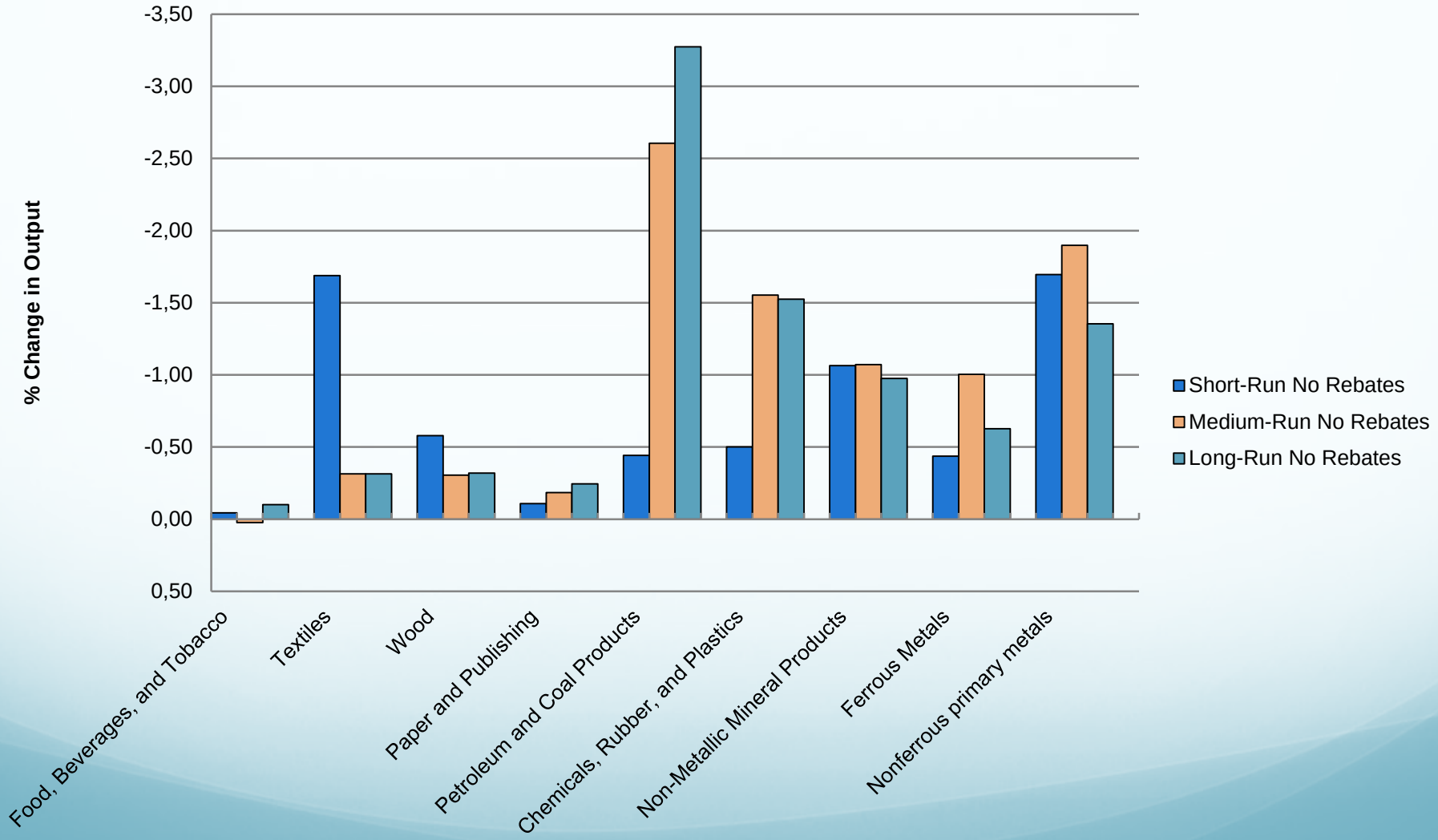
Impacts on Output Vary Over Time

($15/Ton CO2, no Rebates)



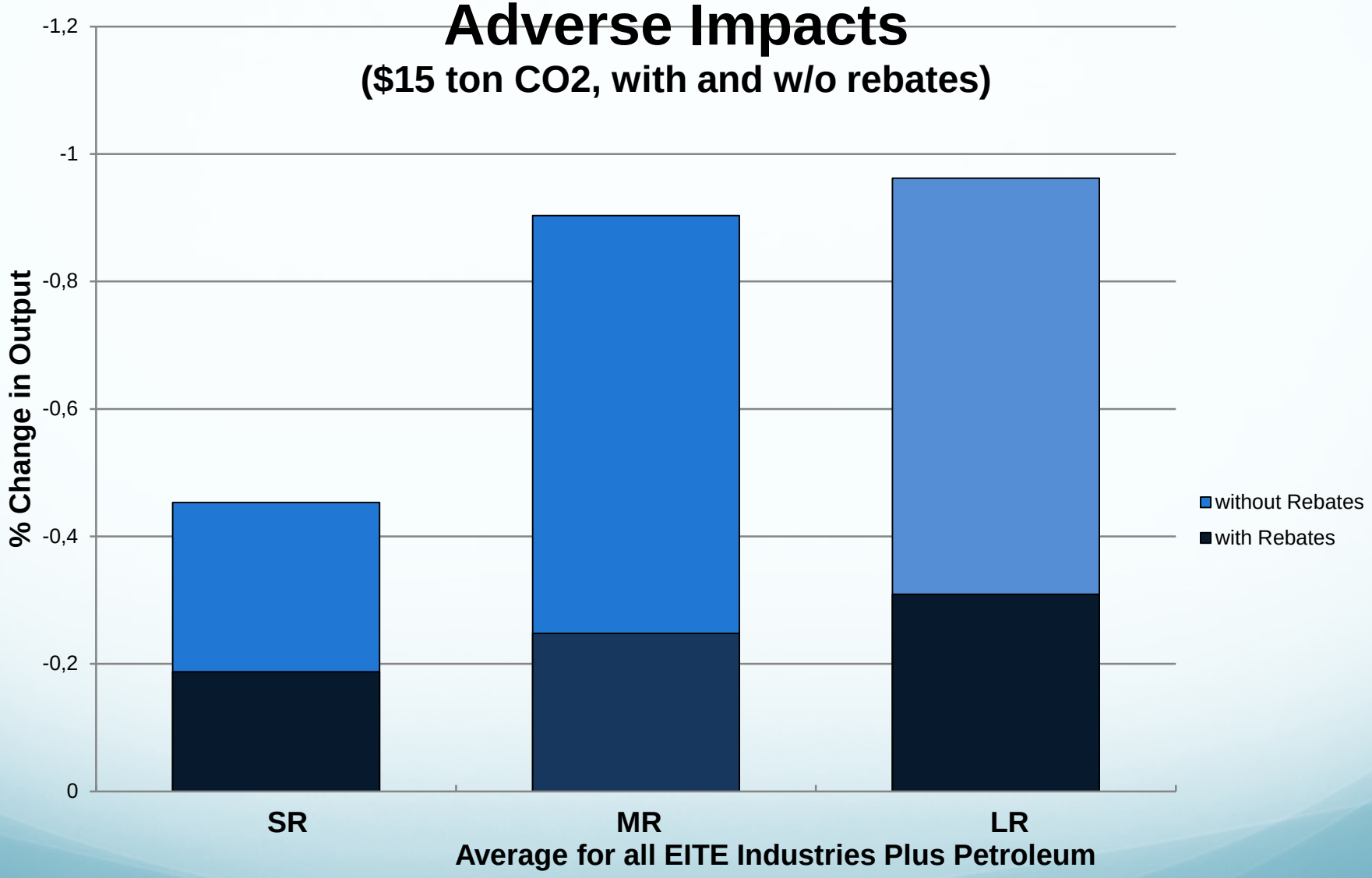
But Impacts Vary Significantly by Industry

($15/Ton Tax, no rebates)



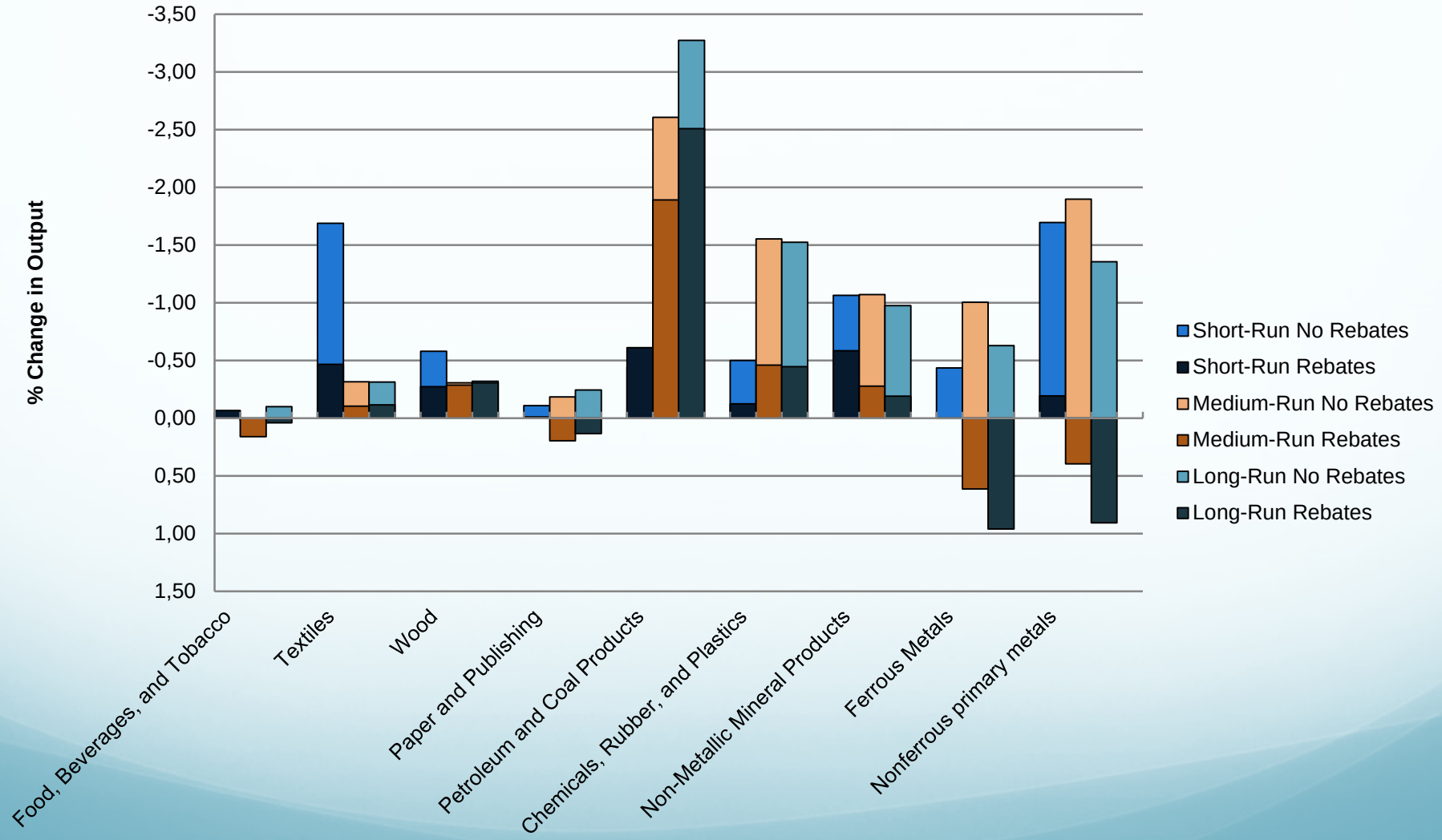
Output Based Rebates Mitigate Most Adverse Impacts

($15 ton CO2, with and w/o rebates)

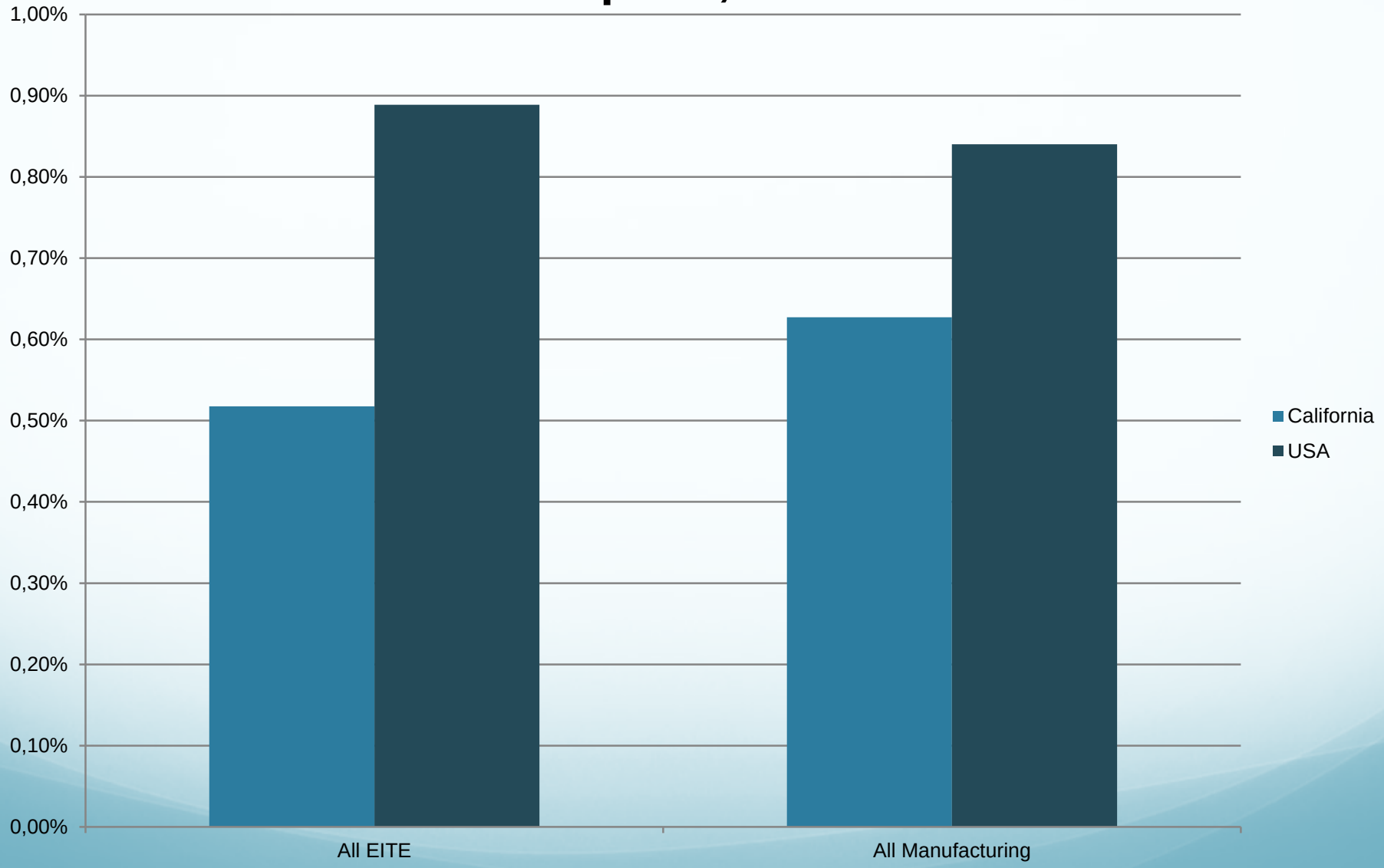


Industry-specific Impacts for EITE Industries

($15/Ton CO2, with and w/o rebates)



California vs US: Changes in Output from $15/ton CO2 price, no rebates



Leakage Classification Analysis in California

- In developing regulatory methods to address leakage, ARB examined the following programs:
  - European Union's Emission Trading Scheme (EU ETS)
  - American Clean Energy and Security Act of 2009 (ACES)
  - Australia's Carbon Pollution Reduction Scheme (CPRS)
- EU ETS, ACES, and CPRS all used a variations of emissions intensity and trade exposure metrics to develop programs to prevent leakage

How ARB Determined Sector Leakage Risk

- ARB determined leakage risk for industrial sectors by:
  - Defining industrial sectors through activity
  - Using a combination of two metrics applied to each sector
    - Emissions intensity of production
    - Trade exposure (i.e., cost pass-through ability)
- ARB used California's Mandatory Reporting Regulation (MRR), U.S. Census, and International Trade Commission data to assess risk
- Staff also requested public input in developing ARB's leakage prevention mechanisms

Defining Sectors and Activities

- A sector is an aggregation of industrial entities that produce reasonably homogeneous goods by reasonably homogenous processes
- Staff used the North American Industry Classification System (NAICS) at the 6-digit level (where able) to group industrial activities
  - The NAICS 6-digit level is the most disaggregated classification for manufacturing facilities that is widely used
- Leakage risk is assessed by activity, not just sector classification

Assessing Emissions Intensity

ARB developed the following metric using MRR and U.S. Census data to measure the emissions intensity of a sector:

emissions intensity =
metric tons CO_2e / $million value added*

** Value added data from the Annual Survey of Manufacturers and the U.S. Economic Census*

The emissions intensity is categorized into four risk levels:

- High: > 5000 $mtCO_2e$/$M value added
- Medium: 4999 to 1000 $mtCO_2e$/$M value added
- Low: 999 to 100 $mtCO_2e$/$M value added
- Very Low: < 100 $mtCO_2e$/$M value added

Assessing Trade Exposure

ARB uses trade share to measure the trade exposure of a sector based upon the following:

trade share =
(imports + exports) / (shipments + imports)*

** Imports, exports, and shipments data from the U.S. Census Bureau and the International Trade Commission*

Trade share is categorized into three risk levels:

- High: > 19 %
- Medium: 19 to 10%
- Low: < 10%

Assessing Leakage Risk

ARB classifies leakage risk into three categories through combining the metrics of emissions intensity and trade exposure

Leakage Risk	Emissions Intensity	Trade Exposure
High	High	High Medium Low
	Medium	High
Medium	Medium	Medium Low
	Low	High Medium
Low	Low	Low
	Very Low	High Medium Low

Leakage Risk Classification and Allocations

From the leakage risk classification, an industry assistance factor (AF) is determined for use among other factors in calculating free allocations

	Industry Assistance Factor (AF)		
	Compliance Period *		
Leakage Risk	1st	2nd	3rd
High	100%	100%	100%
Medium	100%	75%	50%
Low	100%	50%	30%

*1st compliance period: 2013–2014
2nd compliance period: 2015–2017
3rd compliance period: 2018–2020

Potential to Increase Assistance Factor

- i.e., to increase percentages for medium- and low-risk categories for the second and third compliance periods

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	Compliance Period		
Leakage Risk	1st	2nd	3rd
High	100%	100%	100%
Medium	100%	75%	50%
Low	100%	50%	30%

- Potential way to ease transition into Cap-and-Trade Program, thereby minimizing leakage risk

Proposed Research on Agricultural and Industrial Sectors

- ARB is taking steps to refine the analysis of emissions leakage within California's food processing sector

- ARB is sponsoring research efforts to establish a leakage baseline and to identify data-driven metrics to establish leakage risk through analysis of energy prices and trade flows

New Research

- Simulation modeling:
  - How does an increase in energy costs affect equilibrium output and prices by region and industry?
  - Because industries are aggregated, this approach is most useful for broad-scale analysis
- Econometric Analysis:
  - Use past variation in energy prices as a “natural experiment”
  - Advantages: confidential plant-level data enables much more disaggregated analysis, fewer assumptions on market structure

Overview of Econometric Analysis

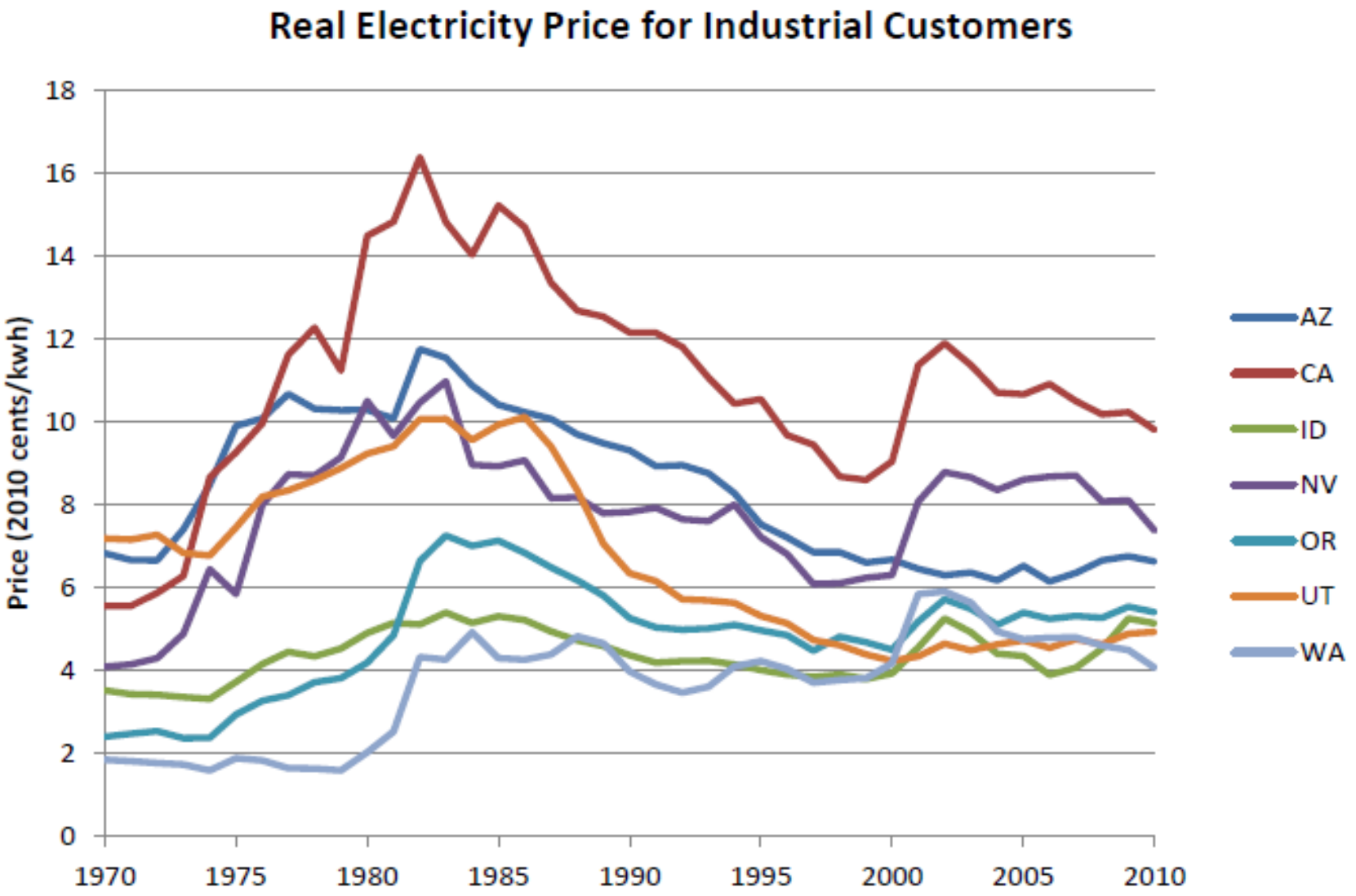
- Use energy prices as proxy for carbon price (natural experiment)
  - Lots of historical variation in energy prices, over time and across regions
  - How do plants respond to energy prices in their own and neighboring regions?
  - Cost metrics include value of shipments, profits, employment, investment, consumption (output plus net imports)
- Counterfactual analysis
  - Suppose energy prices in CA were higher, how would plants inside and outside of CA have responded?
  - Assess leakage/competitiveness effects of a carbon price

Estimation Details

- Sample
  - Assemble data set of plant-year observations that combines Census (every five years) and Annual Survey of Manufactures, 1972-2009
- Key variables
  - Dependent variables: plant-level output, employment, profits
  - Key independent variables: plant-level electricity and natural gas prices, plus energy prices in nearby utility service territories
  - Additional control variables: plant, year, industry fixed effects

Additional Estimation Issues

- Plant energy prices may be correlated with unobserved factors (e.g., productivity)
  - Use instrumental variables for electricity and gas prices
- Effects of environmental regulation could be correlated with energy prices
  - Control for environmental expenditures and/or nonattainment status
- Competitiveness of imports could be correlated with energy prices
- Estimation and simulations rely on cross-state and temporal variation in energy prices



Source: EIA

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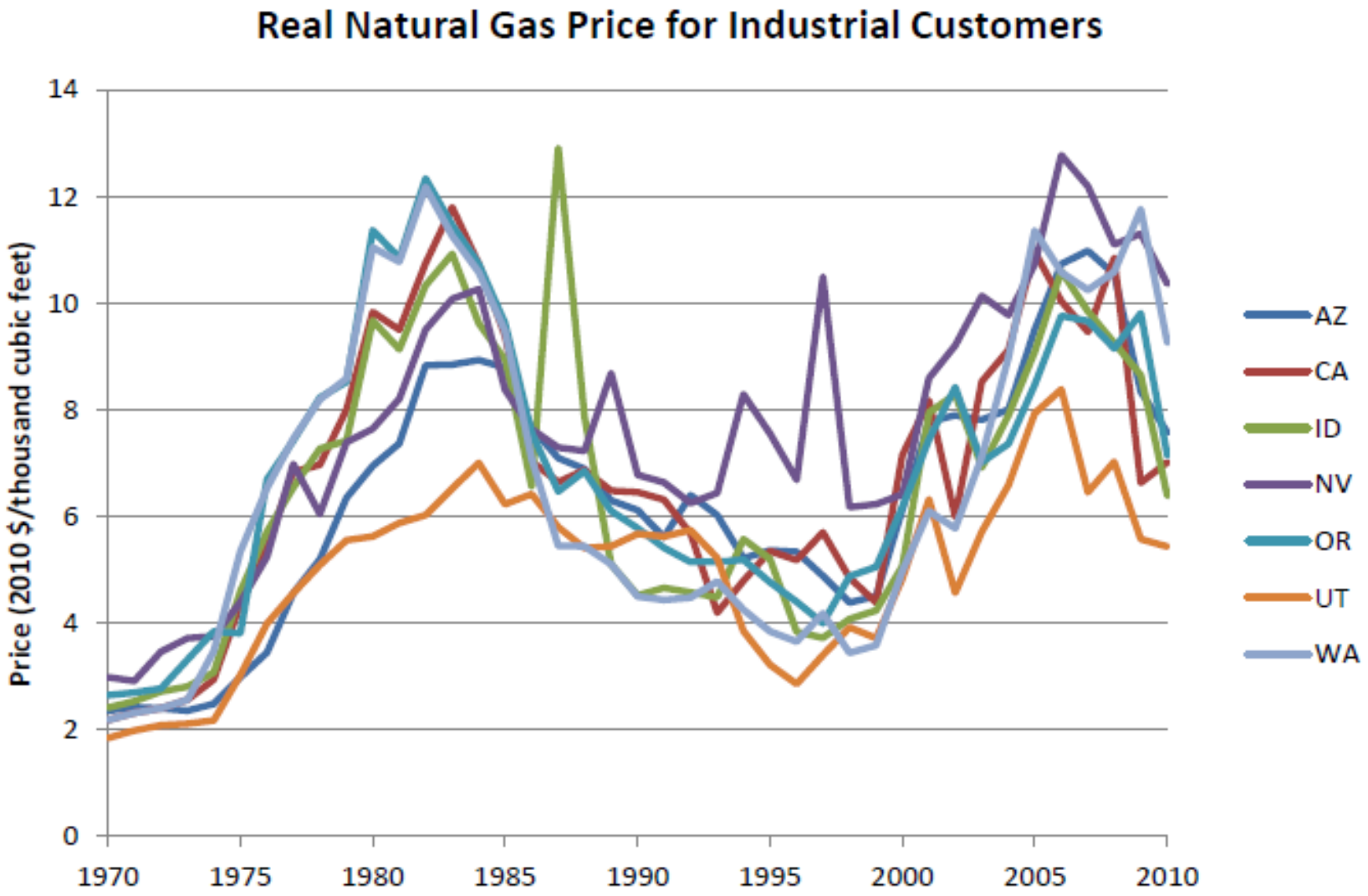

Source: EIA

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Correlations Between State Growth Rates

Panel A: Electricity Prices

	Arizona	California	Idaho	Nevada	Oregon	Utah
California	0.63					
Idaho	0.52	0.56				
Nevada	0.52	0.74	0.51			
Oregon	0.64	0.56	0.69	0.47		
Utah	0.59	0.56	0.68	0.53	0.8	
Washington	0.41	0.44	0.4	0.27	0.75	0.42

Panel B: Natural Gas Prices

	Arizona	California	Idaho	Nevada	Oregon	Utah
California	0.68					
Idaho	0.48	0.37				
Nevada	0.4	0.42	0.28			
Oregon	0.57	0.33	0.49	0.25		
Utah	0.61	0.67	0.33	0.28	0.36	
Washington	0.66	0.65	0.41	0.49	0.6	0.61

Source: Calculated from EIA

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Key Datasets

- Longitudinal Research Database (LRD)
- Manufacturing Energy Consumption Survey (MECS)
- Longitudinal Business Database (LBD)
- Standard Statistical Establishment List (SSEL)
- Pollution Abatement Control Expenditures (PACE)
- Commodity Flow Survey (CFS)
- Attainment/nonattainment status by county
- Utility Service Territory data
- I-O tables

Industries to be Studied

NAICS Code	Industry Name
311	Food Mfg.
3152	Cut and Sew Apparel Mfg.
312120	Breweries
322121	Paper (except Newsprint) Mills
322130	Paperboard Mills
324110	Petroleum Refineries
324199	All Other Petrolem and Coal Products Mfg.
325120	Industrial Gas Manufacturing
325188	All Other Basic Inorganic Chemical Mfg.
325199	All Other Basic Organic Chemical Mfg.
325311	Nitrogenous Fertilizer Mfg.
331511	Iron Foundries
333611	Turbine and Turbine Generator Set Units Mfg.

NAICS Code	Industry Name
325412	Pharmaceutical Preparation Mfg.
325414	Biological Product (except Diagnostic) Mfg.
327211	Flat Glass Mfg.
327213	Glass Container Mfg.
327310	Cement Mfg.
327410	Lime Mfg.
327420	Gypsum Product Mfg.
327993	Mineral Wool Mfg.
331111	Iron and Steel Mills
331221	Rolled Steel Shape Mfg.
331314	Secondary Smelting and Allyoing of Aluminum
331492	Secondary Smelting, Refining, and Alloying of Nonferrous Metal (except Copper and Aluminum)
336411	Aircraft Mfg.
331511	Iron Foundries
333611	Turbine and Turbine Generator Set Units

Short-Run and Long-Run Analysis

- Short run
  - Short-run includes operational responses within a year
  - Estimate effect of plant's and regional energy prices on output, employment, etc.
- Long run
  - Consider longer time horizons using cinquenial Census years
  - Analyze capital stock adjustments using plant level investment as dependent variable
  - Analyze entry and exit by utility territory and year

Expected Research Outputs

- Estimated short-run elasticities of employment, output, and other metrics w.r.t energy prices for NAICS industry
- Simulation of short run impact of AB 32 on plant level output, employment, and emissions for NAICS industries
- Comparable results for long run analysis

Potential Use of Research Results

- Air Resources Board plans to update allocation of free allowances 2015 and beyond
- Analysis of the likely impact of A.B 32 type measures in the recent past can provide input to new CA allocation decisions
- Can serve as laboratory for national-level analyses of competiveness/leakage…and input to possible new policies

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Thank you