The US electricity industry after 20 years of restructuring

James Bushnell:

UC Davis, and NBER

(Joint with Severin Borenstein, UC Berkeley and NBER)

UCDAVIS
UNIVERSITY OF CALIFORNIA

ENERGY INSTITUTE AT HAAS

Outline

- The political economy of US Deregulation
- Industry background
  - Costs and prices; AC in regulatory terms.
  - What exactly *is* restructuring?
- Why electricity restructuring has disappointed policymakers in the US
- What is next for the industry
- Caveat: this talk is *not* about the California Crisis
  - Market power not a big part of today's story

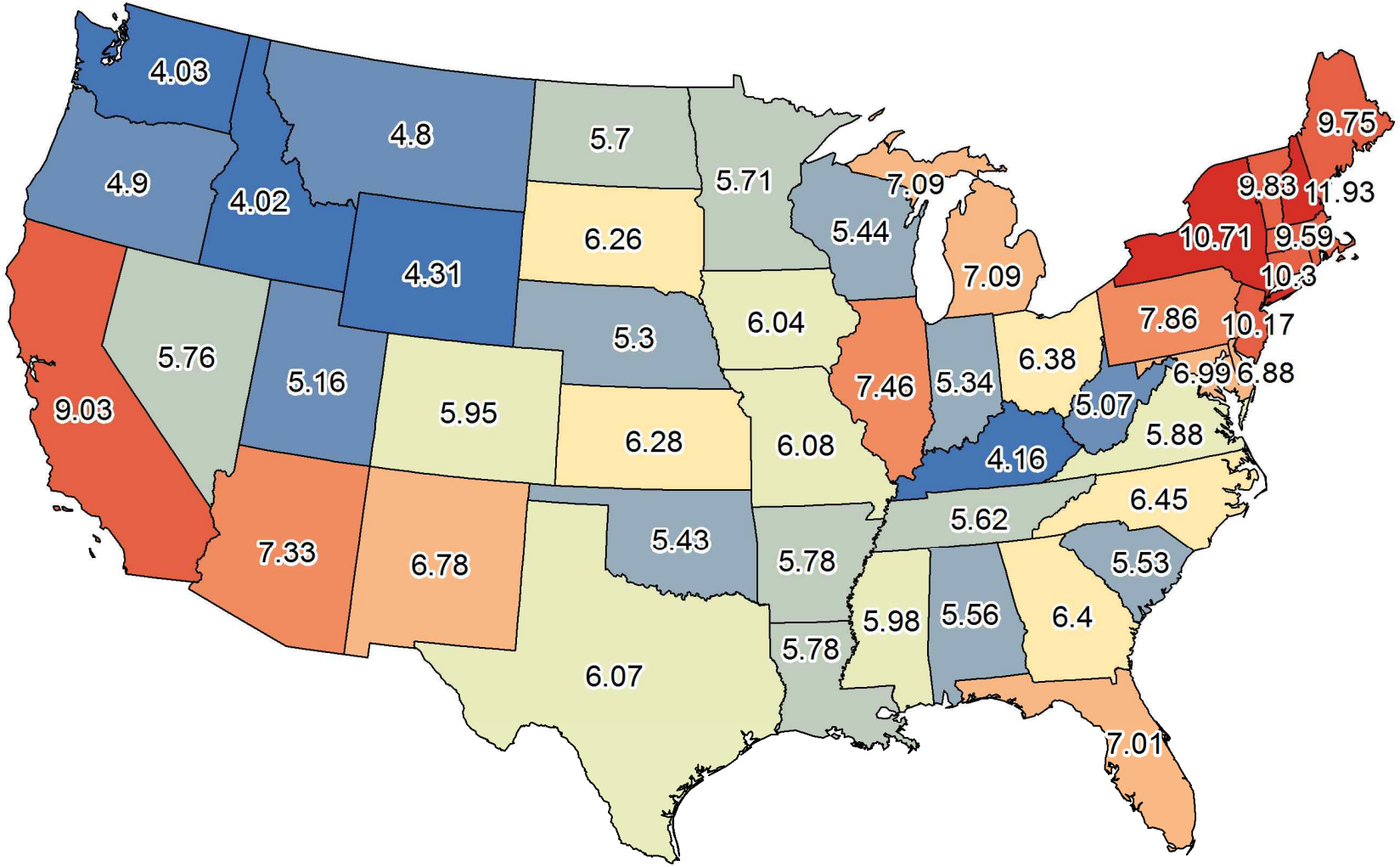
Sequence of changes to the Electric Utility Business

- Traditional model of vertical integration
  - Generation/transmission/distribution/billing within one company
    - Some trading of wholesale power across utilities
  - BUT then cracks in the traditional model appeared
- First crack: independent power producers
  - Need access to transmission and utilities are only customers
- Second crack: retail choice for energy supply
  - Customers get “direct access” to generators, but need transmission
- Third crack: self (“distributed”) generation
  - But distributed solar/wind still needs to sell through the grid
- Fourth crack???: storage => grid disconnect ??

Central Premise

- The last 30 years of electricity policy have been largely influenced by attempts to avoid paying for fixed/sunk costs.
  - Regulated prices ~ average costs
  - Market prices ~ marginal costs The attractiveness of this strategy fluctuates over time.
  - As “reforms” work it can reduce costs (sunk and otherwise) and provide benefits
    - But those efficiency gains are likely dwarfed by the transfers at stake,

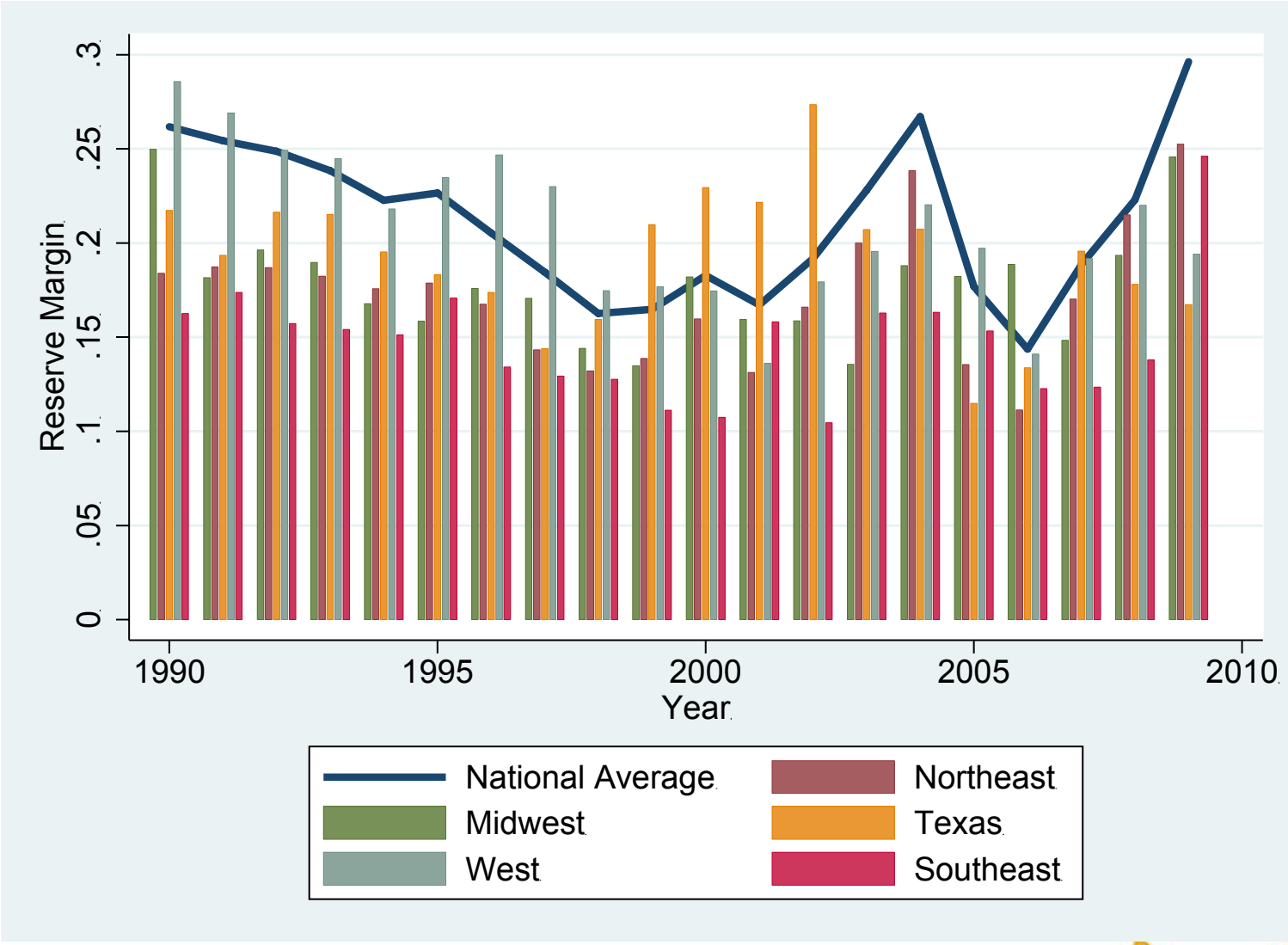
Rate of Return Regulation Produced Widely Varying Results: 1998 Average Retail Prices



UC DAVIS
UNIVERSITY OF CALIFORNIA

ENERGY INSTITUTE AT HAAS

US Generation Capacity Reserve Margins



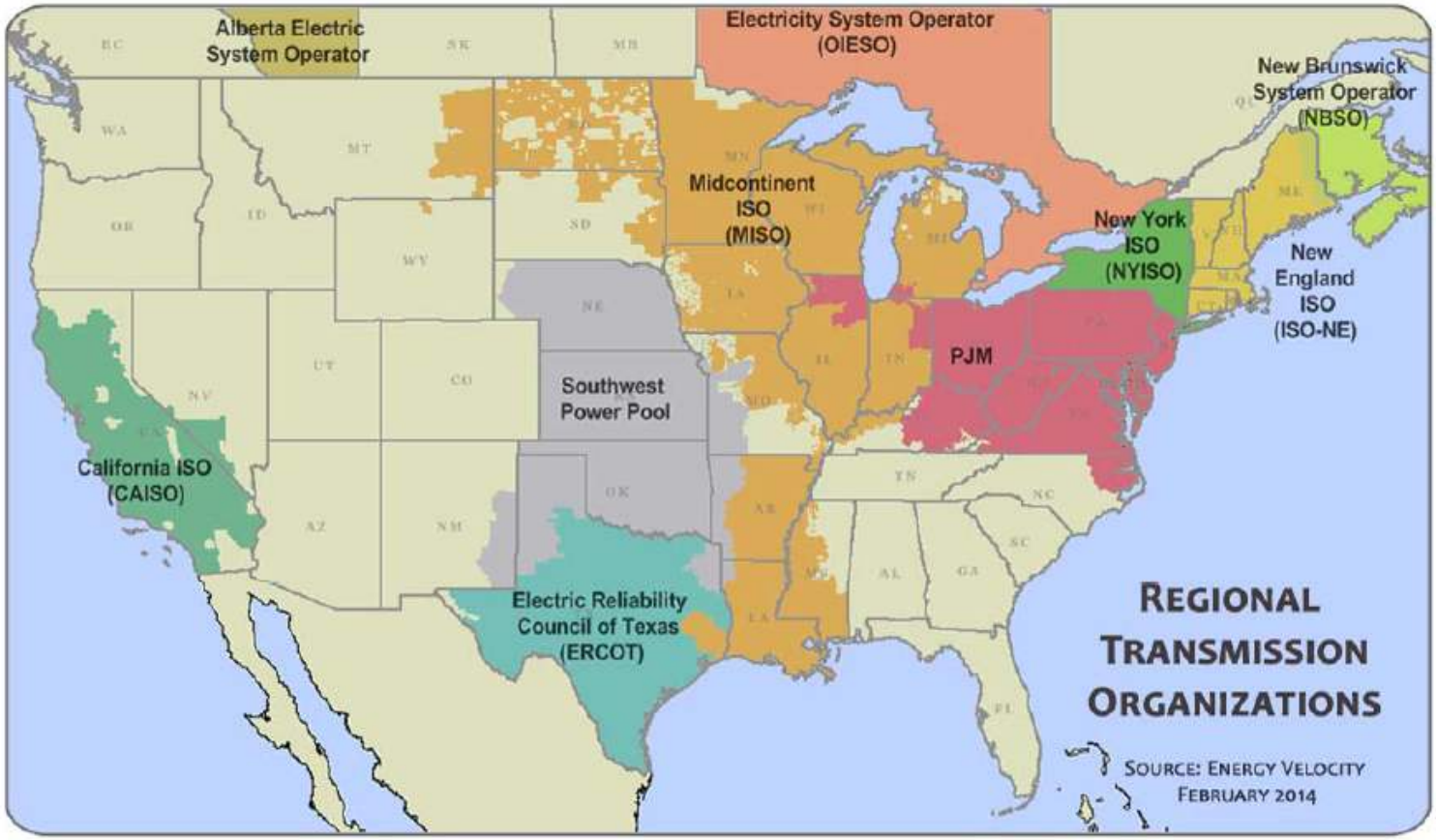
UC DAVIS
UNIVERSITY OF CALIFORNIA

ENERGY INSTITUTE AT HAAS

US Electricity Restructuring: What is it?

- Transmission (vertical) reforms
  - Create ISOs – or "order" open access
  - Operate short-term "balancing" markets
  - Maintain system reliability

Defining Liberalization (1)
Organization of Wholesale Markets



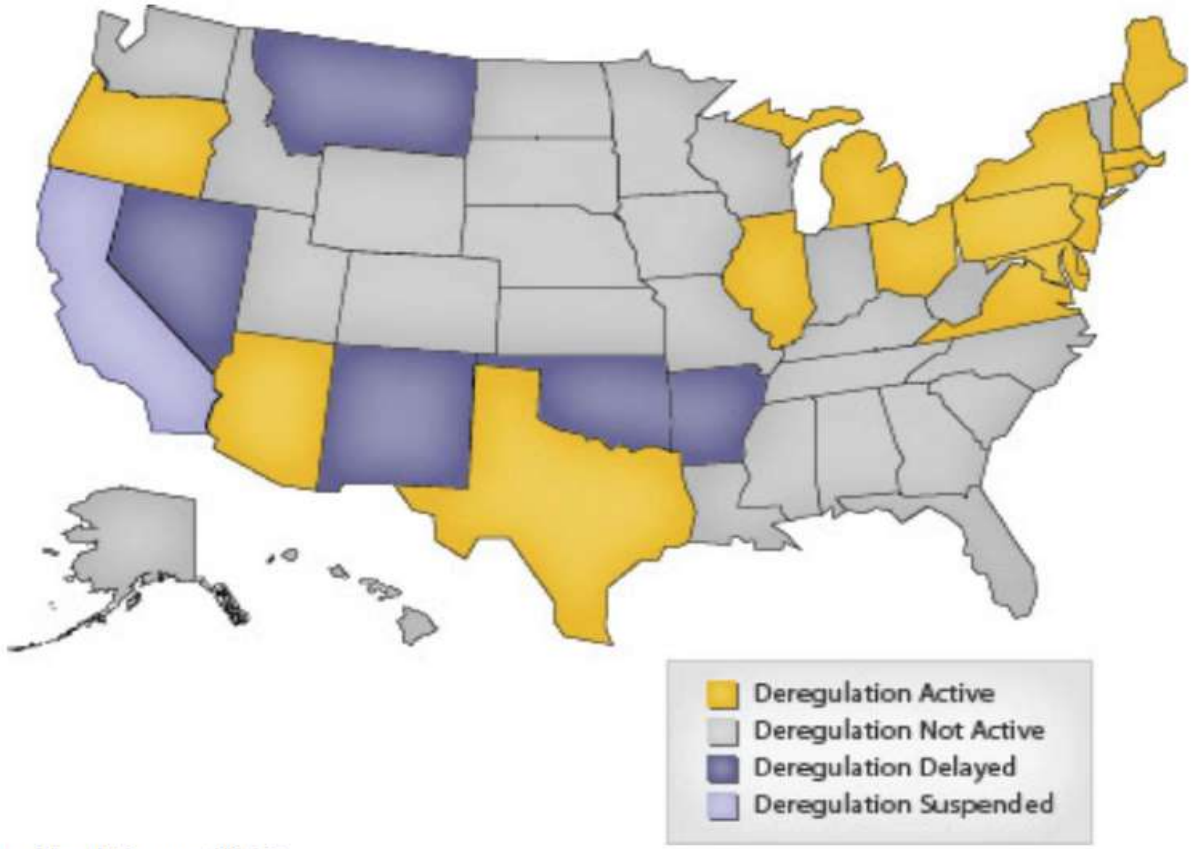
UC DAVIS UNIVERSITY OF CALIFORNIA

ENERGY INSTITUTE AT HAAS

US Electricity Restructuring: What is it?

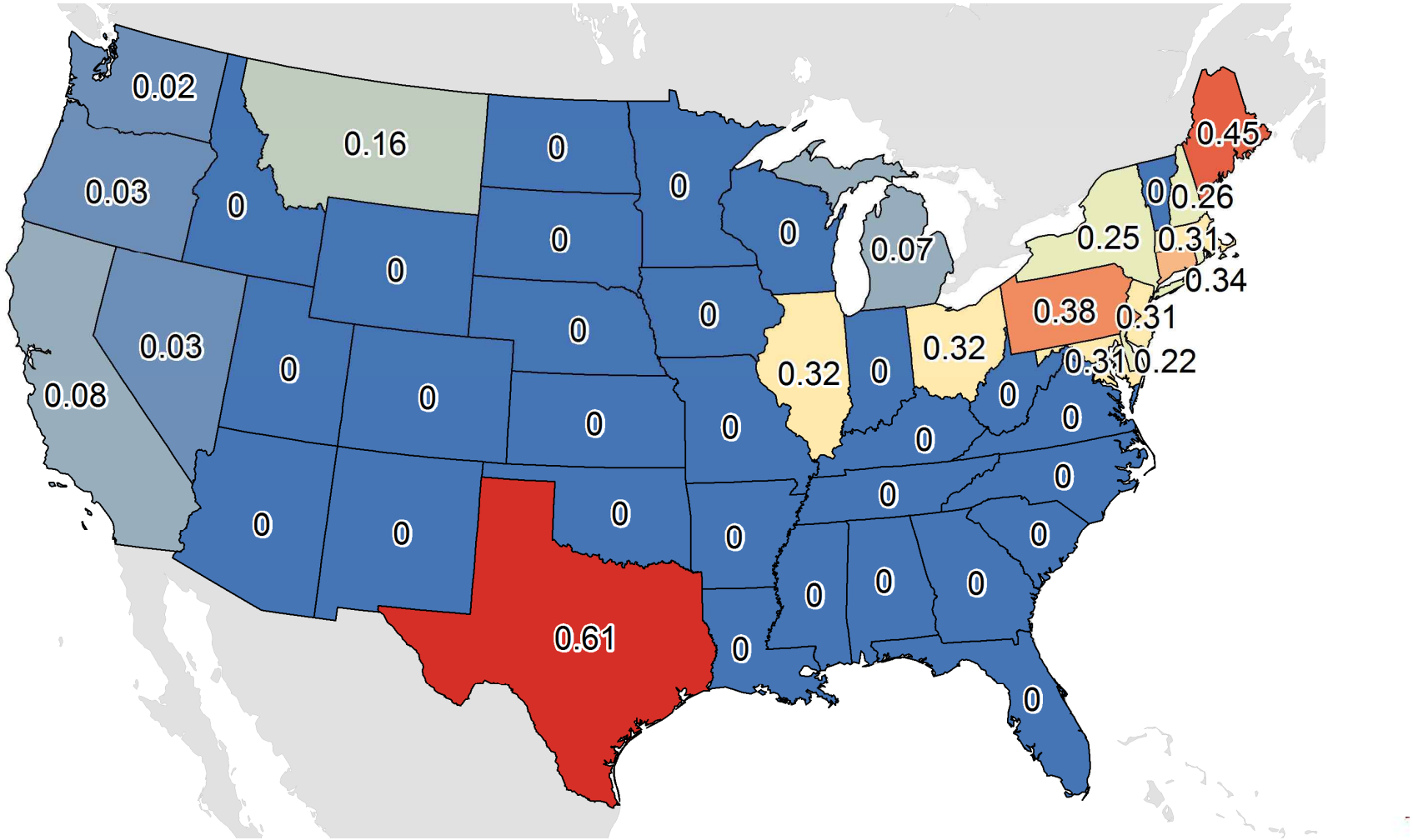
- Transmission (vertical) reforms
  - Create ISOs – or "order" open access
  - Operate short-term "balancing" markets
  - Maintain system reliability
- Retail Competition
  - Customers free to migrate to new retailer (energy provider)
  - Customers who do nothing pay "default" rates
  - During a transition – default retail rates often fixed to allow for stranded cost recovery by incumbents

Defining Liberalization (2):
Retail “choice”



Source: ClearlyEnergy (2014)

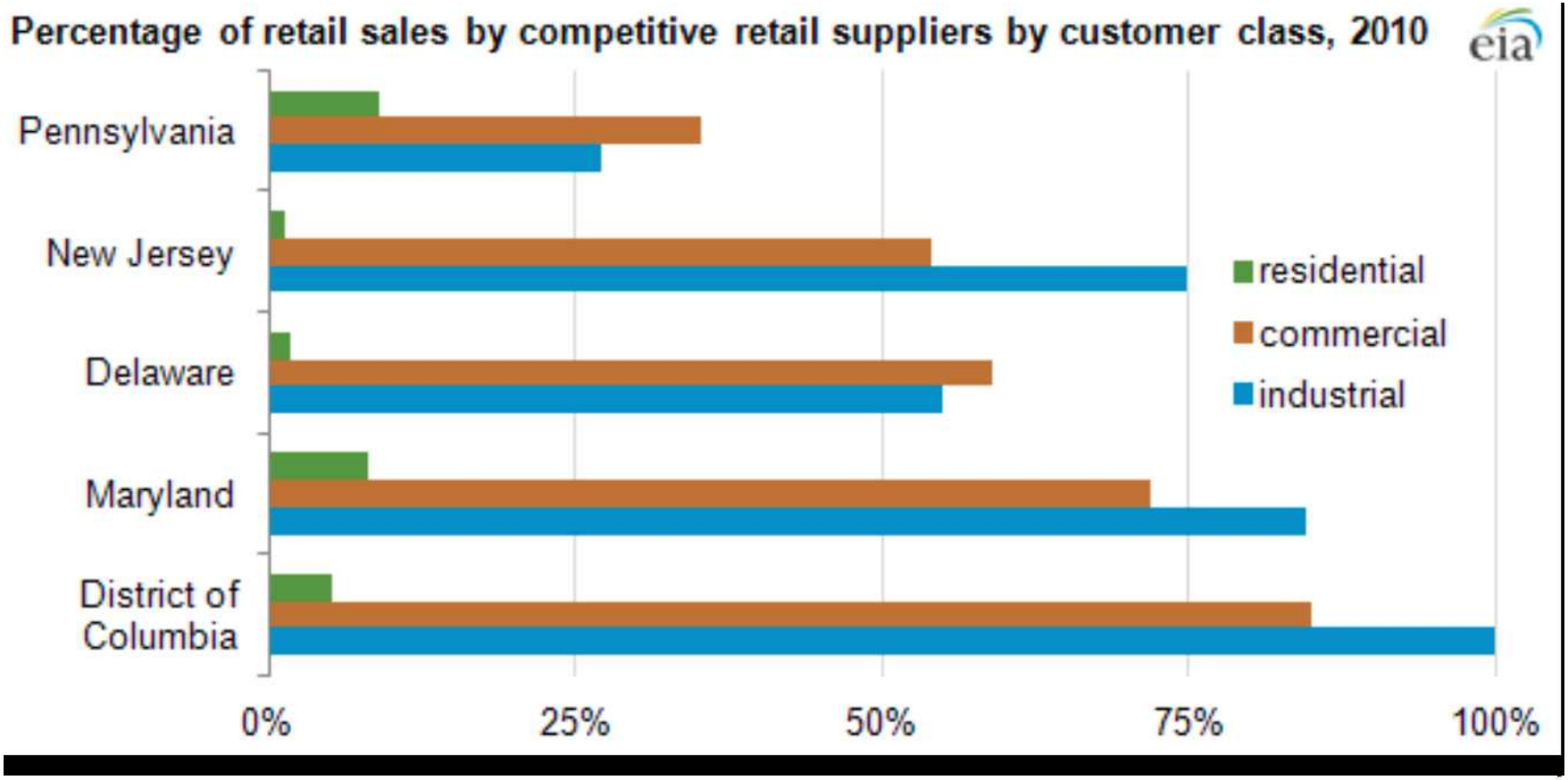
Retail Choice is Thriving only in Texas



UCDAVIS
UNIVERSITY OF CALIFORNIA

ENERGY INSTITUTE AT HAAS

Residential Sector is Avoiding Choice



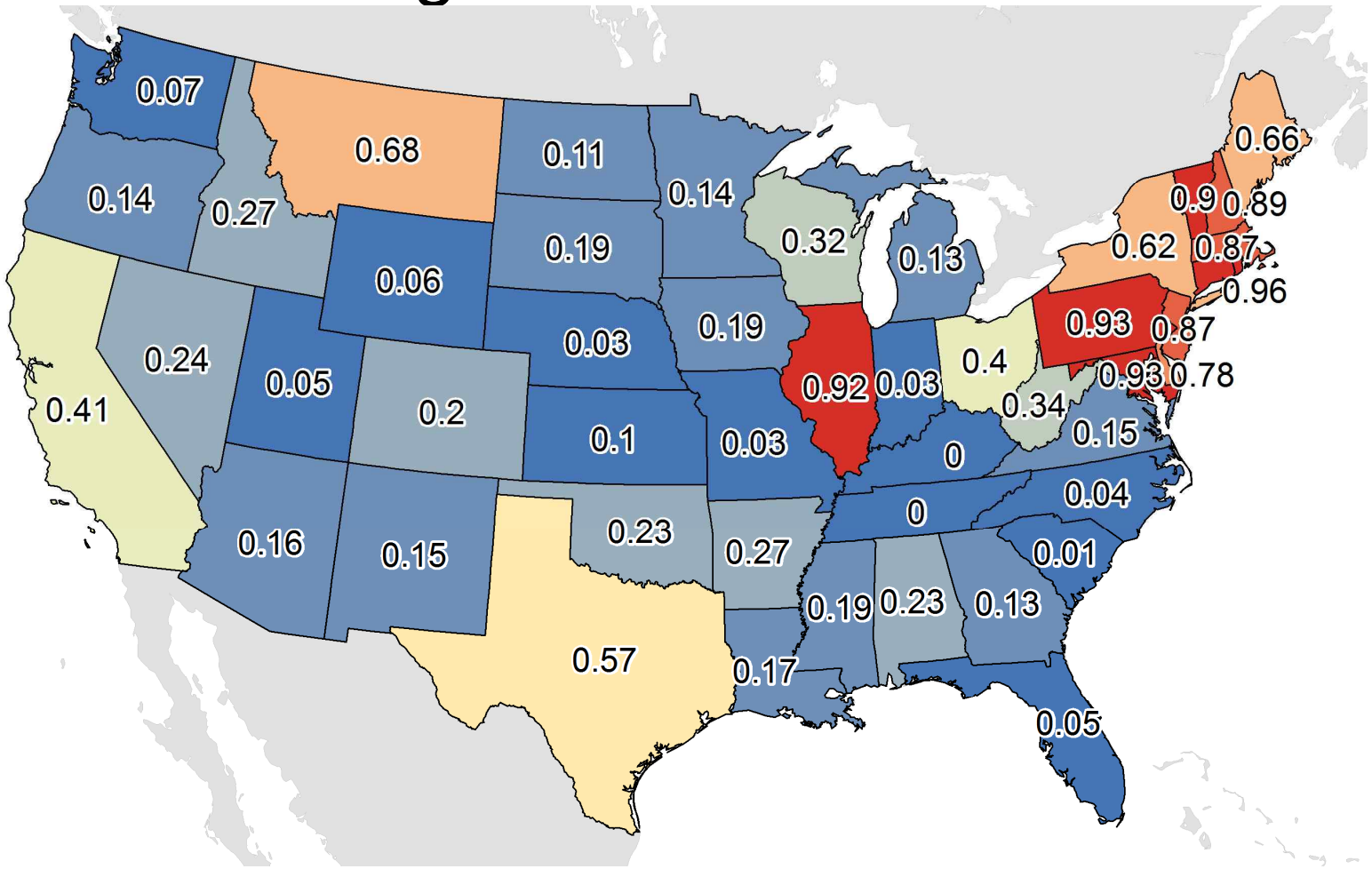
UC DAVIS
UNIVERSITY OF CALIFORNIA

ENERGY INSTITUTE AT HAAS

US Electricity Restructuring: What is it?

- Transmission (vertical) reforms
  - Create ISOs – or "order" open access
  - Operate short-term "balancing" markets
  - Maintain system reliability
- Retail Competition
  - Customers free to migrate to new retailer (energy provider)
  - Customers who do nothing pay "default" rates
  - During a transition – default retail rates often fixed to allow for stranded cost recovery by incumbents
- Changes to Generation Remuneration
  - Shift from cost-based to market based payments for production
    - Analogous to shifting to "rent" from "own"
  - Mix of divestiture/new entry

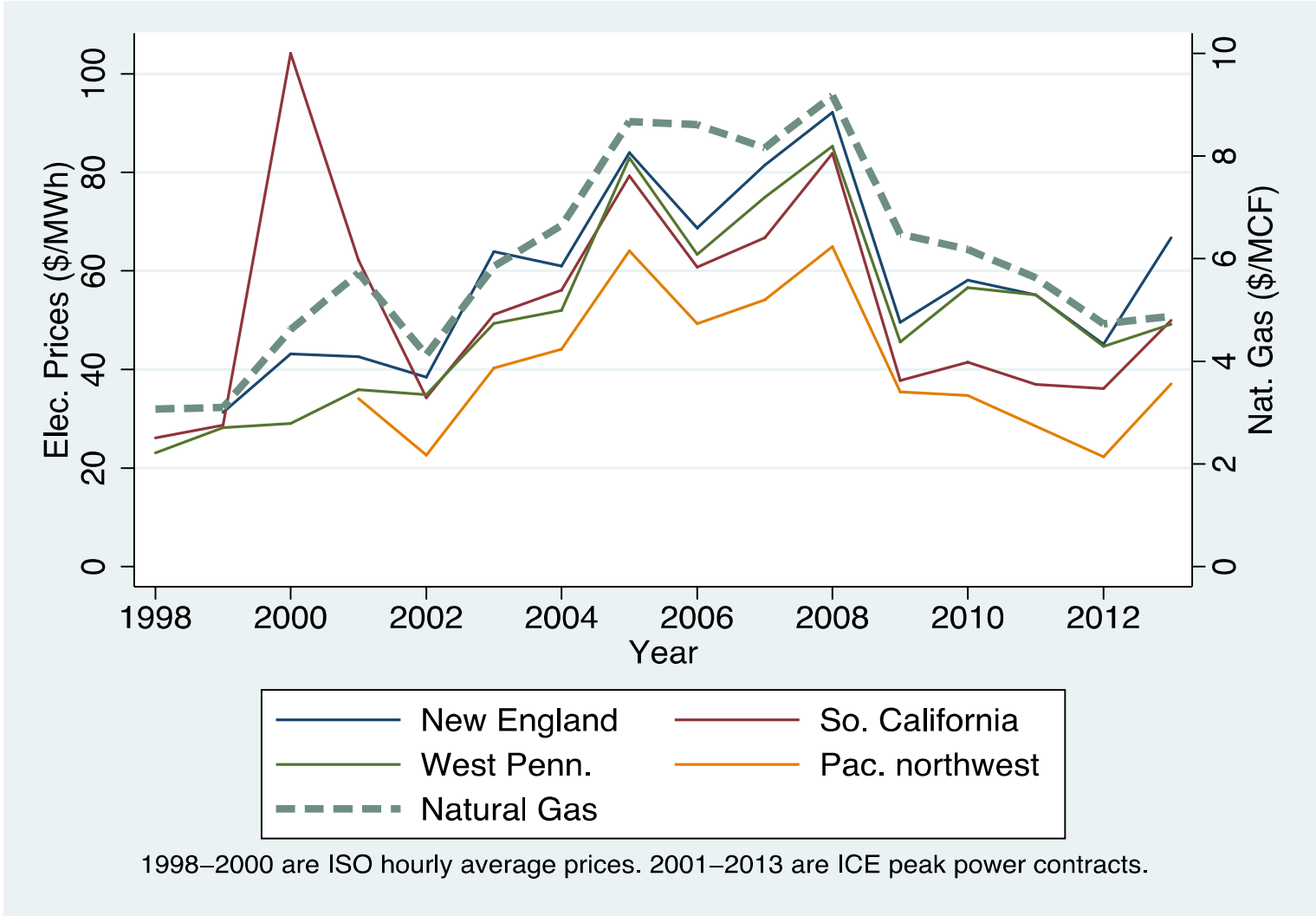
Defining Liberalization (3):
Deregulation of Generation



UCDAVIS
UNIVERSITY OF CALIFORNIA

ENERGY INSTITUTE AT HAAS

Wholesale Prices in Power Markets



1998–2000 are ISO hourly average prices. 2001–2013 are ICE peak power contracts.

UC DAVIS UNIVERSITY OF CALIFORNIA

ENERGY INSTITUTE AT HAAS

The New York Times
nytimes.com

October 15, 2006

Competitive Era Fails to Shrink Electric Bills

By DAVID CAY JOHNSTON

The Electricity Journal

Competition Has Not Lowered U.S. Industrial Electricity Prices

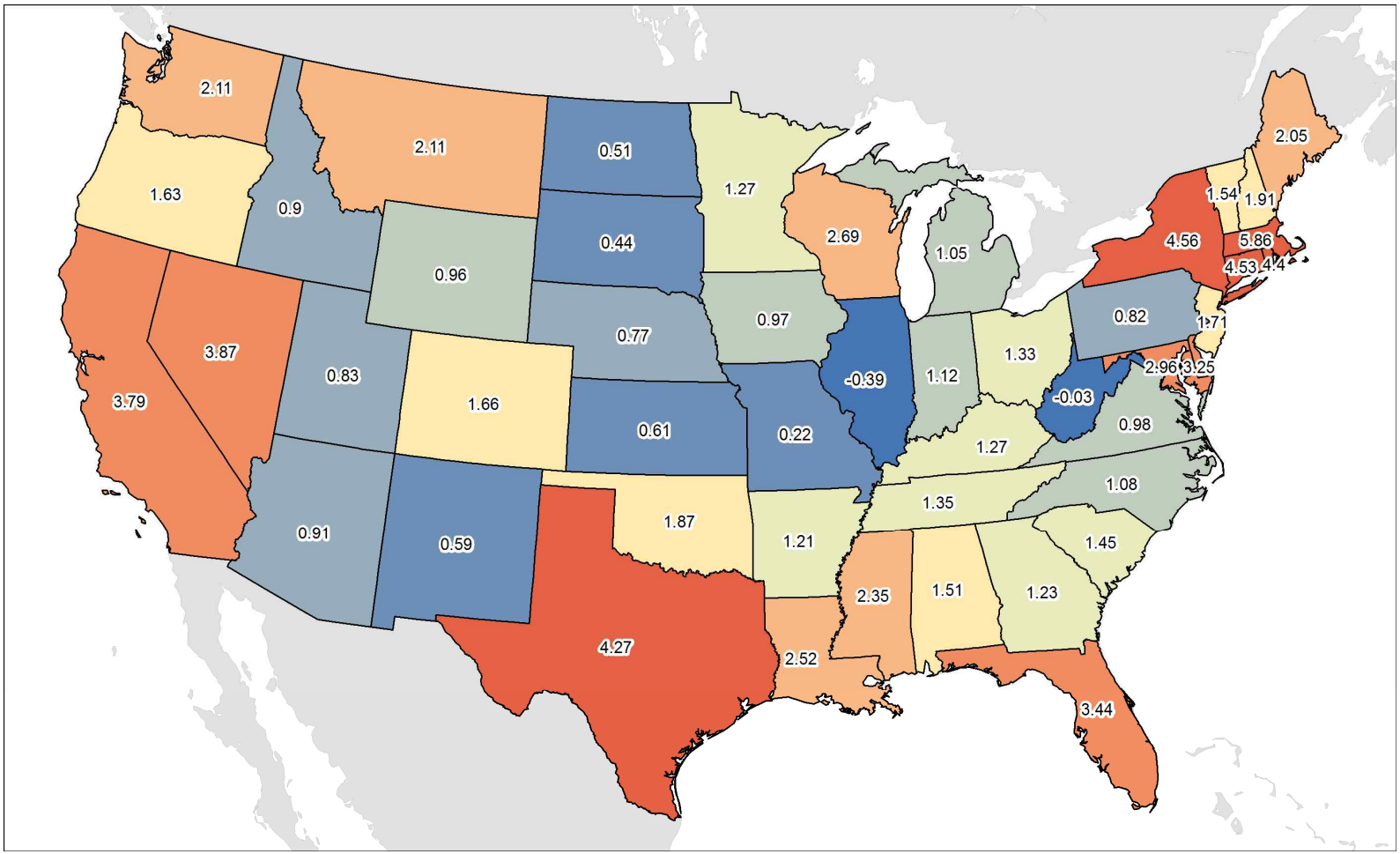
Previous studies have shown that significant price reductions resulted from deregulation in airlines, trucking, railroads, and natural gas. Retail electricity price data from 1990 through 2003 show no such benefit to industrial customers.

Jay Apt

UCDAVIS
UNIVERSITY OF CALIFORNIA

ENERGY INSTITUTE AT HAAS

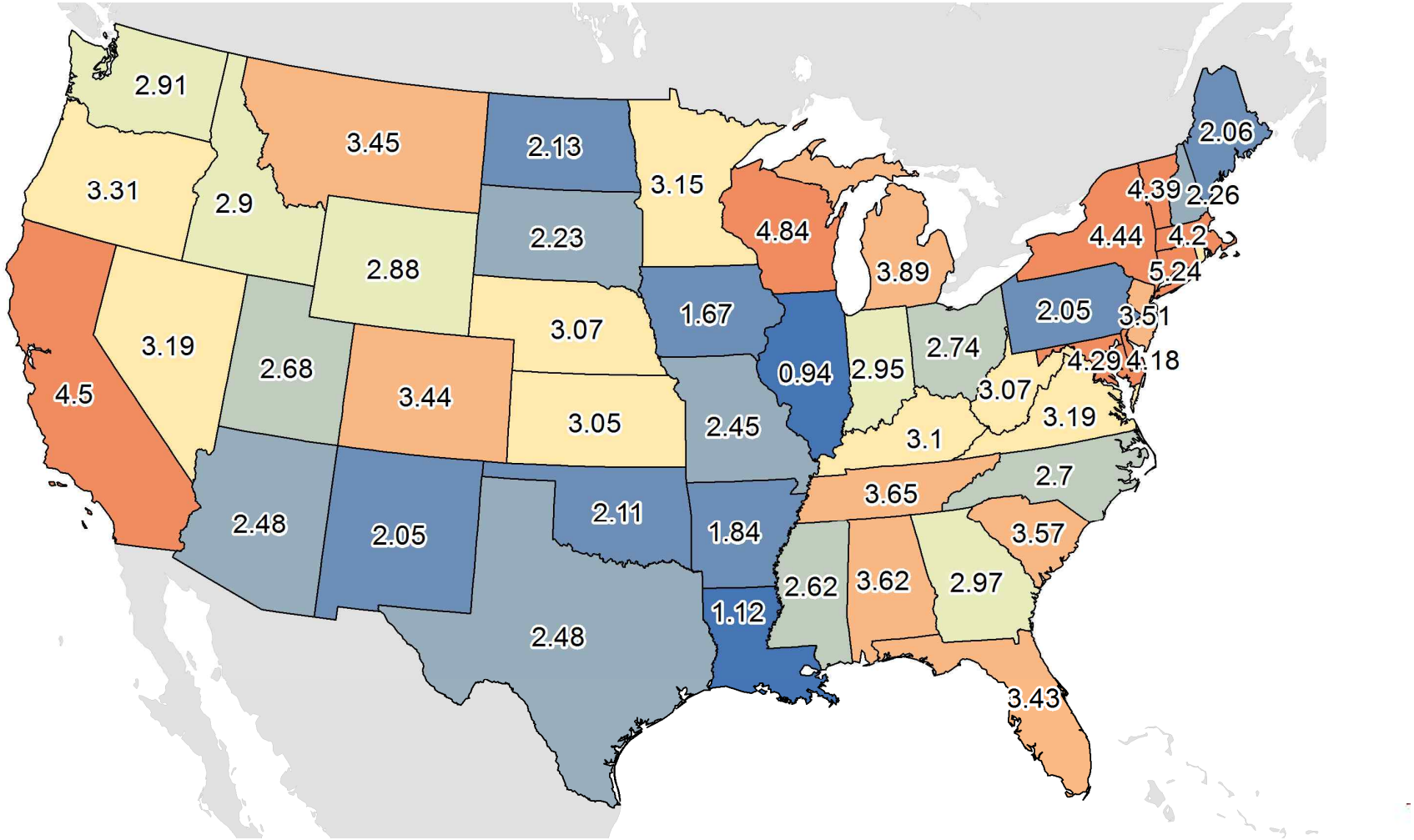
Retail Price Changes: 1998-2006



UCDAVIS
UNIVERSITY OF CALIFORNIA

ENERGY INSTITUTE AT HAAS

Retail Price Changes: 1998-2012



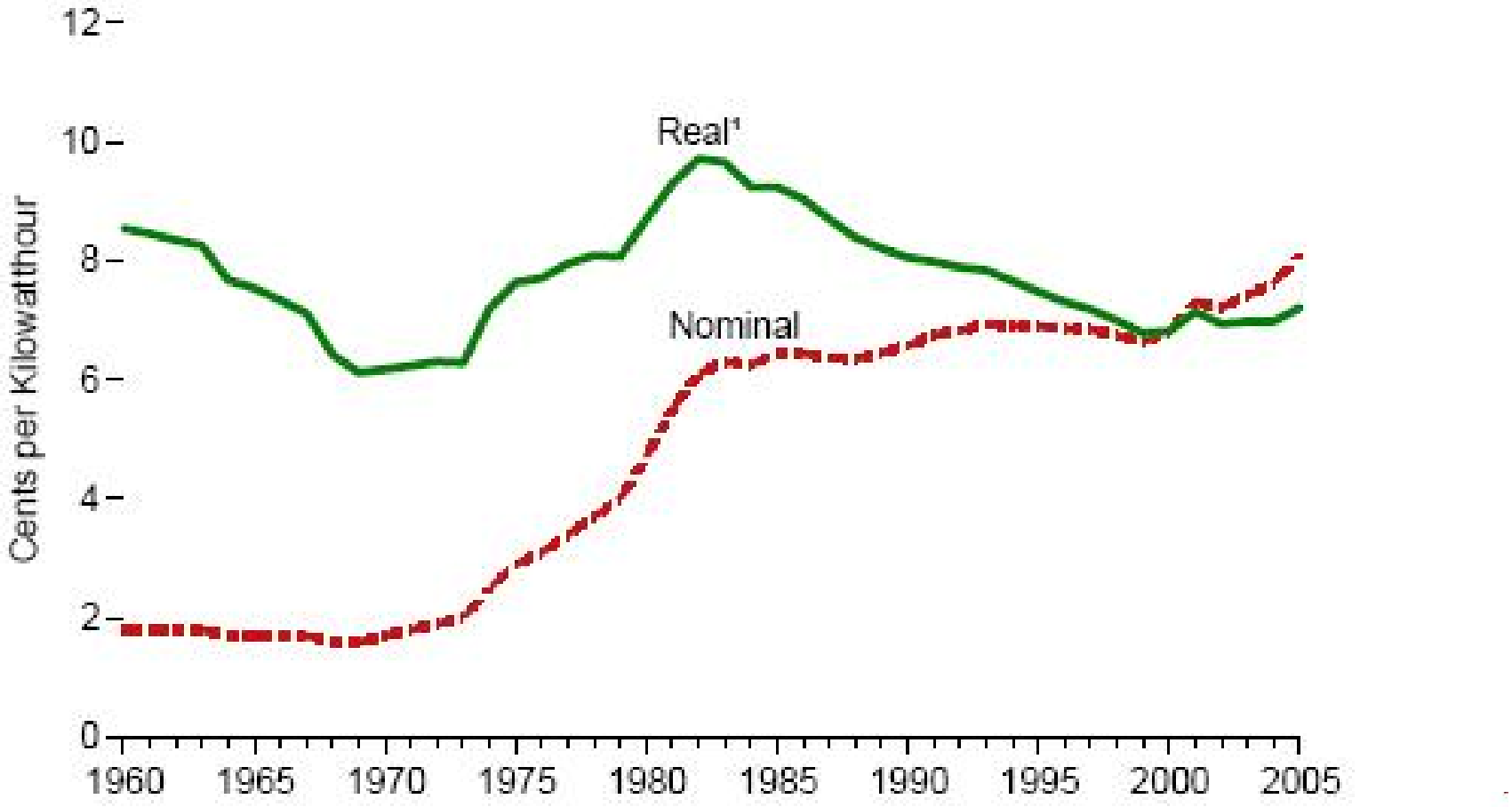
UCDAVIS
UNIVERSITY OF CALIFORNIA

ENERGY INSTITUTE AT HAAS

The difficulty in judging the impacts of restructuring

- The challenges with a focus on retail rates
  - Tremendous time lags between wholesale and retail outcomes in many regions
  - Controlling for diversity in starting conditions
  - Isolating impacts of restructuring from other changes
- Marginal Cost (deregulation) will at times be above and at times below Average Cost (regulation)
  - Which looks better depends upon *when* you look

Average Retail Price of Electricity, 1960-2005

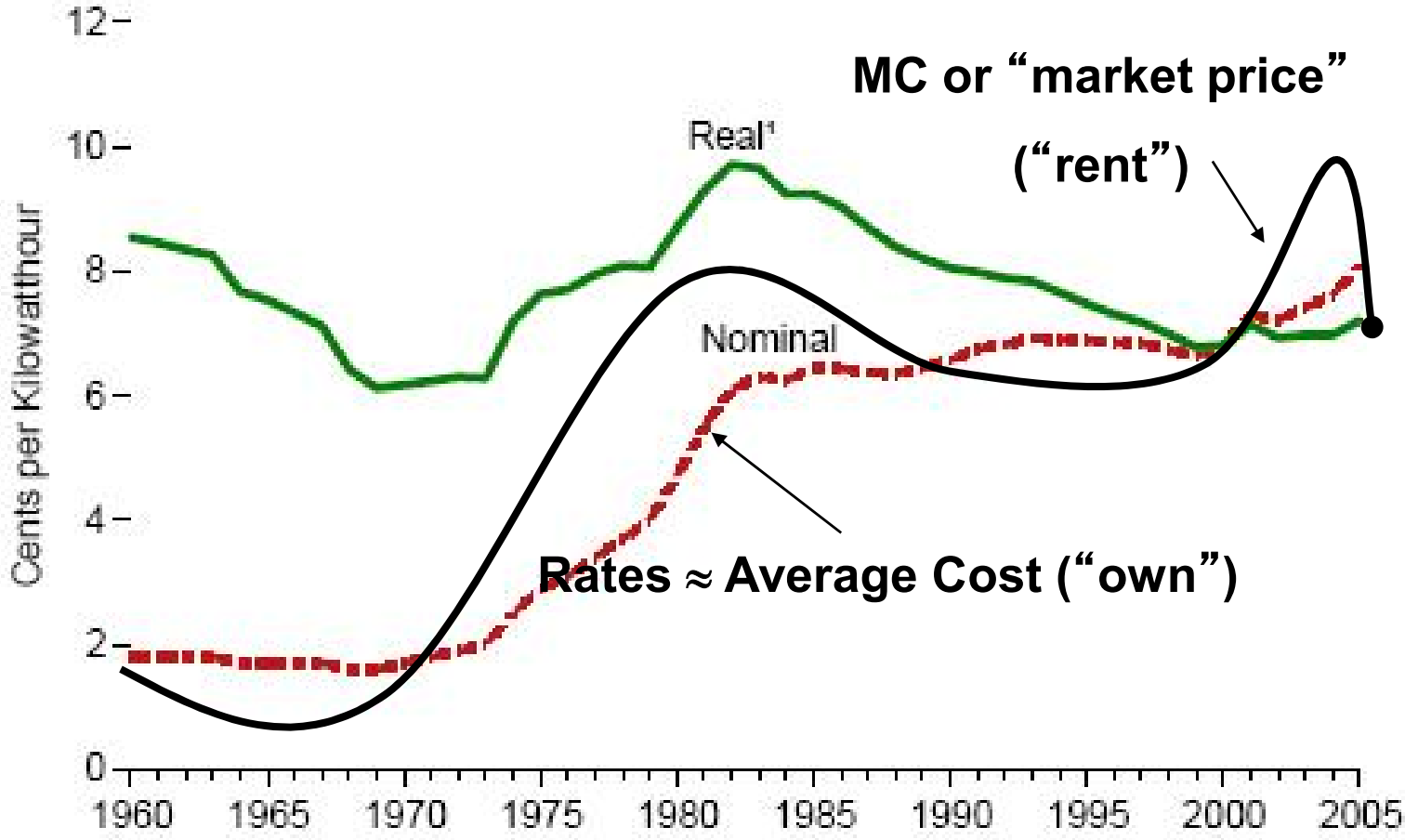


Source: EIA, http://www.eia.doe.gov/emeu/aer/pdf/pages/sec8_38.pdf.

UC DAVIS
UNIVERSITY OF CALIFORNIA

ENERGY INSTITUTE AT HAAS

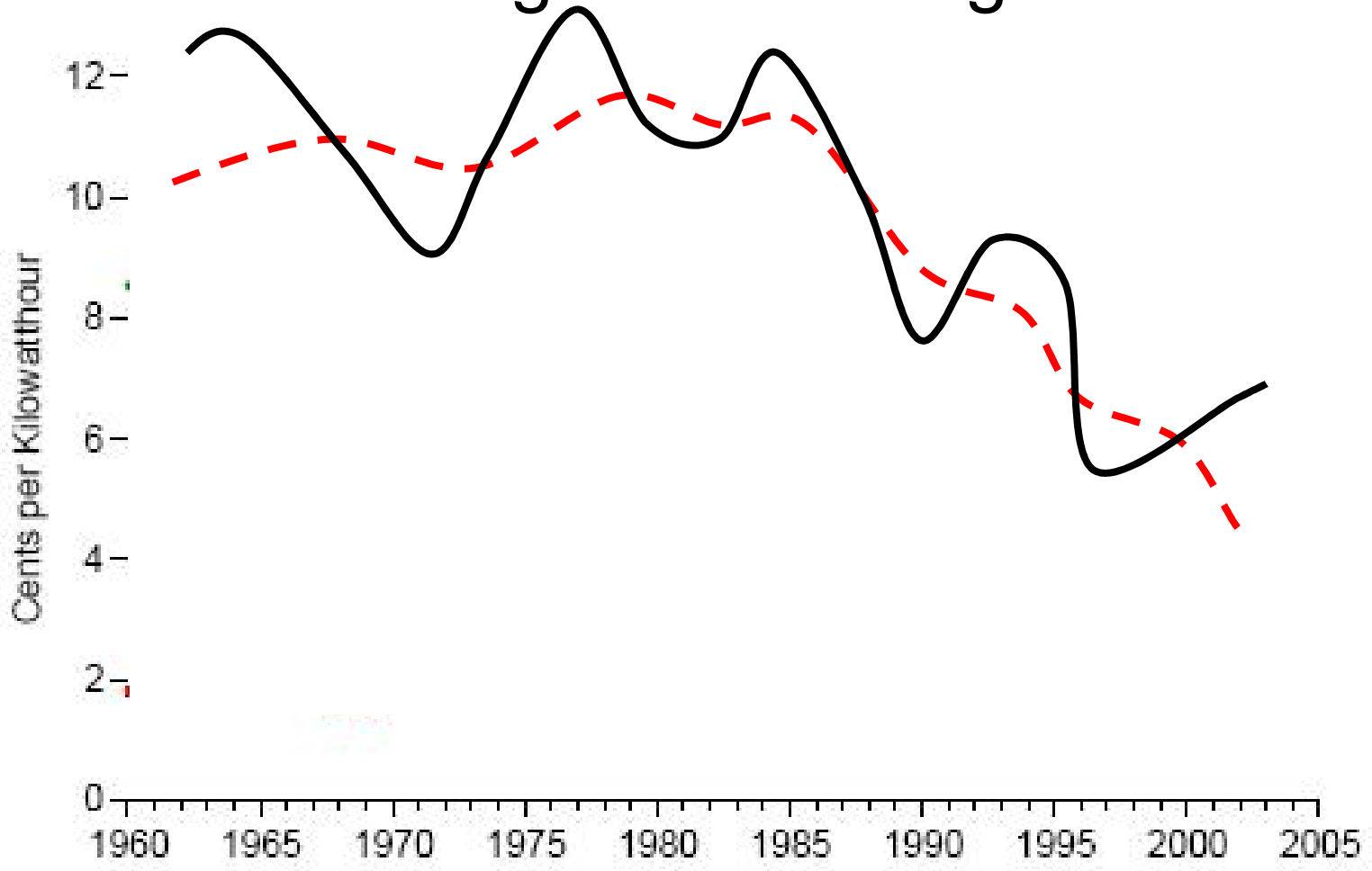
Average Retail Price of Electricity, 1960-2005



Source: EIA, http://www.eia.doe.gov/emeu/aer/pdf/pages/sec8_38.pdf.

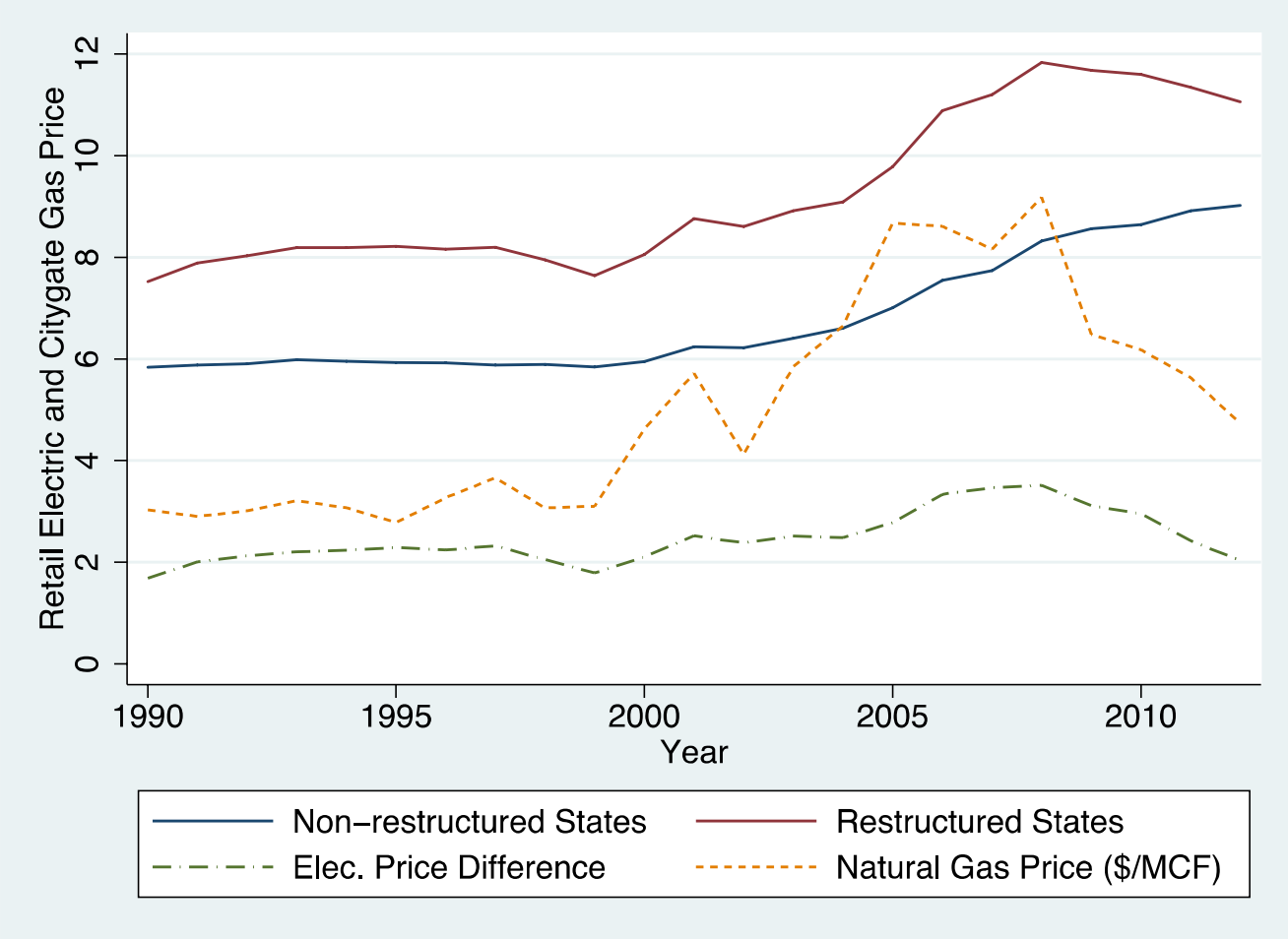
Source for Black Line: Artists Rendering (I.e. I made it up)

Theoretical (hoped for) Impact of Restructuring: both costs go down



Source: Completely fictional data made up by me.

Retail Rates in Restructured vs. Regulated States



UC DAVIS
UNIVERSITY OF CALIFORNIA

ENERGY INSTITUTE AT HAAS

Retail Rate Changes Since 1997

Table 1 Summary of Retail Price Changes

Definition	Status	Average Retail Price			Percent Change		
		1997	2007	2012	97 to 07	07 to 12	98 to 12
PPI Definition	Regulated	5.89	7.44	8.72	0.21	0.15	0.32
	Restructured	8.96	12.53	12.35	0.29	-0.01	0.27
At least 40%	Regulated	5.67	7.23	8.57	0.22	0.16	0.34
IPP in 2012	Restructured	8.83	11.99	11.95	0.26	0.00	0.26

$$\Delta Elec_{s,t} = \alpha + \beta_1 FractionIPP_{s,t} + \beta_2 \Delta NGas_{s,t} + \beta_3 FractionIPP_{s,t} * \Delta NG_{s,t}, \quad (1)$$

Table 2 Summary Statistics of Retail Electric and Natural Gas Prices

Variable	Mean	S.D.	Min	Max
Data for 1997				
Variable	Mean	S.D.	Min	Max
Price	6.72	2.03	3.87	11.66
Fraction IPP	0.03	0.07	0.00	0.46
Nat. Gas	3.54	0.64	2.12	5.18
Data for 2012				
Price	9.70	2.30	6.90	15.54
Fraction IPP	0.35	0.33	0.00	0.99
Nat. Gas	4.90	0.97	3.46	7.73

$$\Delta Elec_{s,t} = \alpha + \beta_1 FractionIPP_{s,t} + \beta_2 \Delta NGas_{s,t} + \beta_3 FractionIPP_{s,t} * \Delta NG_{s,t}, \quad (1)$$

Table 3 Analysis of Retail Price Changes

	1	2	3
Pct IPP	0.006	0.007	0.006
	(0.005)	(0.005)	(0.005)
Pct Change in		0.051	0.023
Nat. Gas		(0.016)	(0.016)
ΔNGasxPctIPP		NA	0.018
			(0.005)
N	720	720	720

Dependent variable is change in log annual state-level average electricity rates. Standard Errors are clustered by state.

The Next 20 Years

- Tension between average and marginal cost has migrated to the arena of *distributed generation.*
- Expansion of grid scale renewables lowering marginal costs while raising average costs
- Customer level renewables (rooftop solar) offer an escape from most fixed and sunk costs
  - Problem is exacerbated by retail rate structures
  - Almost certainly constitutes inefficient bypass

Income Investing

News, analysis and commentary on income-generating investments.

May 23, 2014, 11:45 A.M. ET

Barclays Downgrades Electric Utility Bonds, Sees Viable Solar Competition

By Michael Aneiro

Barclays this week downgrades the entire electric sector of the U.S. high-grade corporate bond market to underweight, saying it sees long-term challenges to electric utilities from solar energy, and that the electric sector of the bond market isn't pricing in these challenges right now. It's a noteworthy downgrade since electric utilities which make up nearly 7.5% of Barclays' U.S. Corporate Index by market value. From Barclays credit strategy team:

> Electric utilities… are seen by many investors as a sturdy and defensive subset of the investment grade universe. Over the next few years, however, we believe that a confluence of declining cost trends in distributed solar photovoltaic (PV) power generation and residential-scale power storage is likely to disrupt the status quo. Based on our analysis, the cost of solar + storage for residential consumers of electricity is already competitive with the price of utility grid power in Hawaii. Of the other major markets, California could follow in 2017, New York and Arizona in 2018, and many other states soon after.
>
> In the 100+ year history of the electric utility industry, there has never before been a truly cost-competitive substitute available for grid power. We believe that solar + storage could reconfigure the organization and regulation of the electric power business over the coming decade. We see near-term risks to credit from regulators and utilities falling behind the solar + storage adoption curve and long-term risks from a comprehensive re-imagining of the role utilities play in providing electric power.

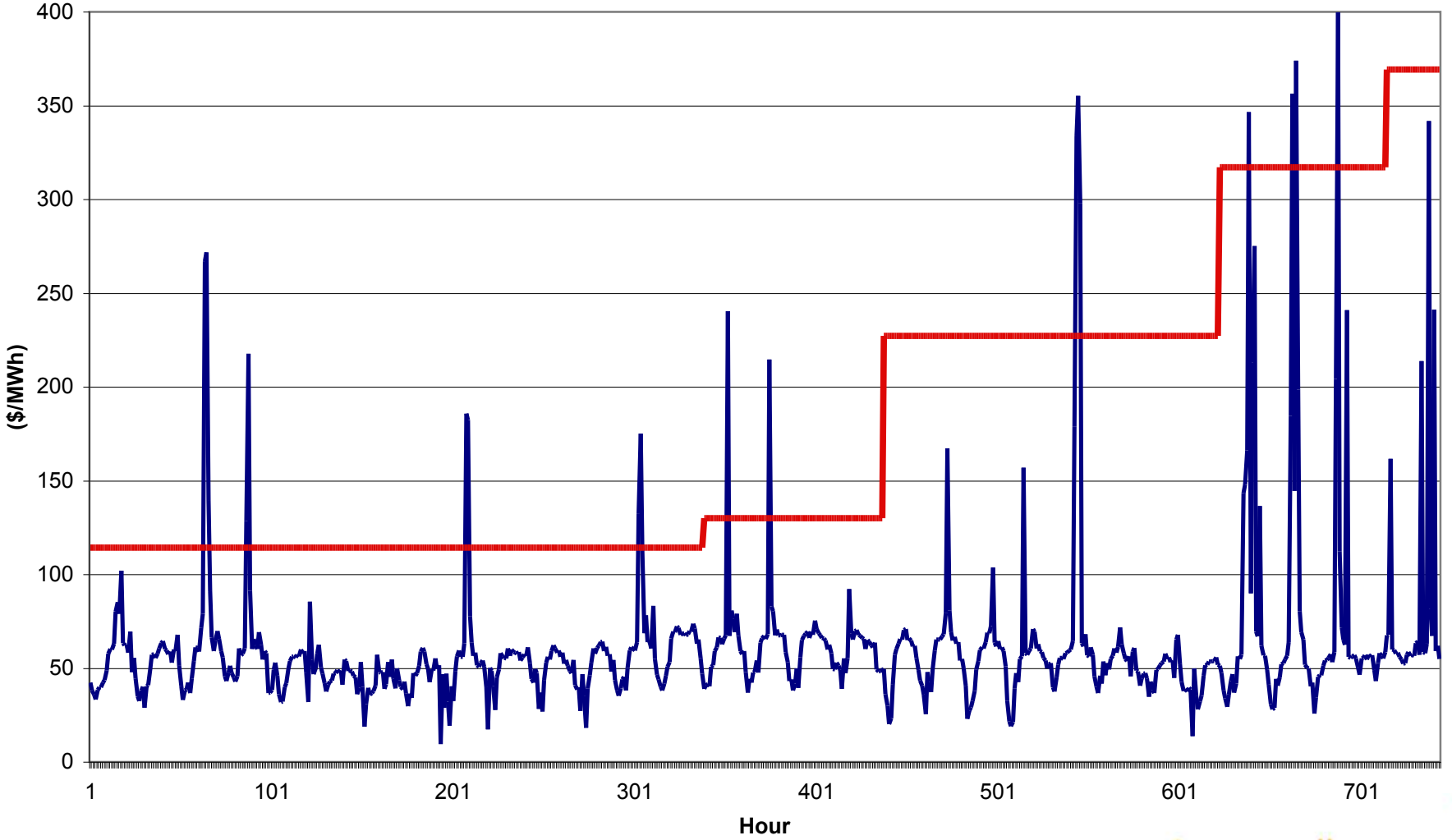
Technological Change Since 2000

- Large Expansion of Grid-Scale Renewables
- Rapid growth (from smaller base) of distributed generation (e.g. solar rooftops)
- Large-scale deployment of “smart-meters”
- Advances in development and acceptance of home-automation systems.
- Improved sensor/switching/computational capabilities for large-scale grids

Technology and the Utility/Consumer Relationship: Two Pathways

- Path 1: Technology tightly integrates individual energy users with their regional grid
  - Two-way communication between users and wholesale market operators.
  - Massively distributed responses to changes in wholesale market conditions.
    - Responses largely automated through home automation of thermostats and management systems
- Path 2: Technology and policy encourages customers to isolate themselves from the regional grid.
  - Storage and distributed generation technologies allow for “cord cutting” with local utility.
  - Formation of “micro-grids” creates pockets of self-sustaining but isolated networks.

Wholesale and Retail Prices August 2007
Customer B - large residential user



UCDAVIS
UNIVERSITY OF CALIFORNIA

ENERGY INSTITUTE AT HAAS

Ratemaking can Determine the Pathway

- Rate design can either provide incentive for more efficient participation of customers
  - Rates that encourage dynamic participation of loads
  - Potential for incorporating distribution level conditions
- Or it can encourage the deployment of new technologies in ways that predominately avoid paying for sunk costs.
  - Rates that charge for fixed costs in variable components
- Reminiscent of factors driving retail choice in the mid 1990s.

Not everyone agrees on prices that reflect costs

PUC Must Reject PG&E Plan to Cut Incentives

Mercury News – Letters to the Editor, September 22, 2014

PG&E has proposed changes that protect its monopoly and could cripple the market for its main competition: rooftop solar. The crux of PG&E's proposal is to add $10 in monthly, unavoidable fixed charges to your bill. By making customer bills less dependent on actual energy consumption and forcing people to pay no matter how much energy they use, the incentive to produce your own energy and reduce dependence on dirty grid power is dramatically reduced.

Matt Vespa

Senior attorney Sierra Club

Thank You!

UC DAVIS
UNIVERSITY OF CALIFORNIA

ENERGY INSTITUTE AT HAAS