Getting Retail Electricity Prices Right

Richard L. Sweeney

Intro

Review: Efficiency of MWTP = MC

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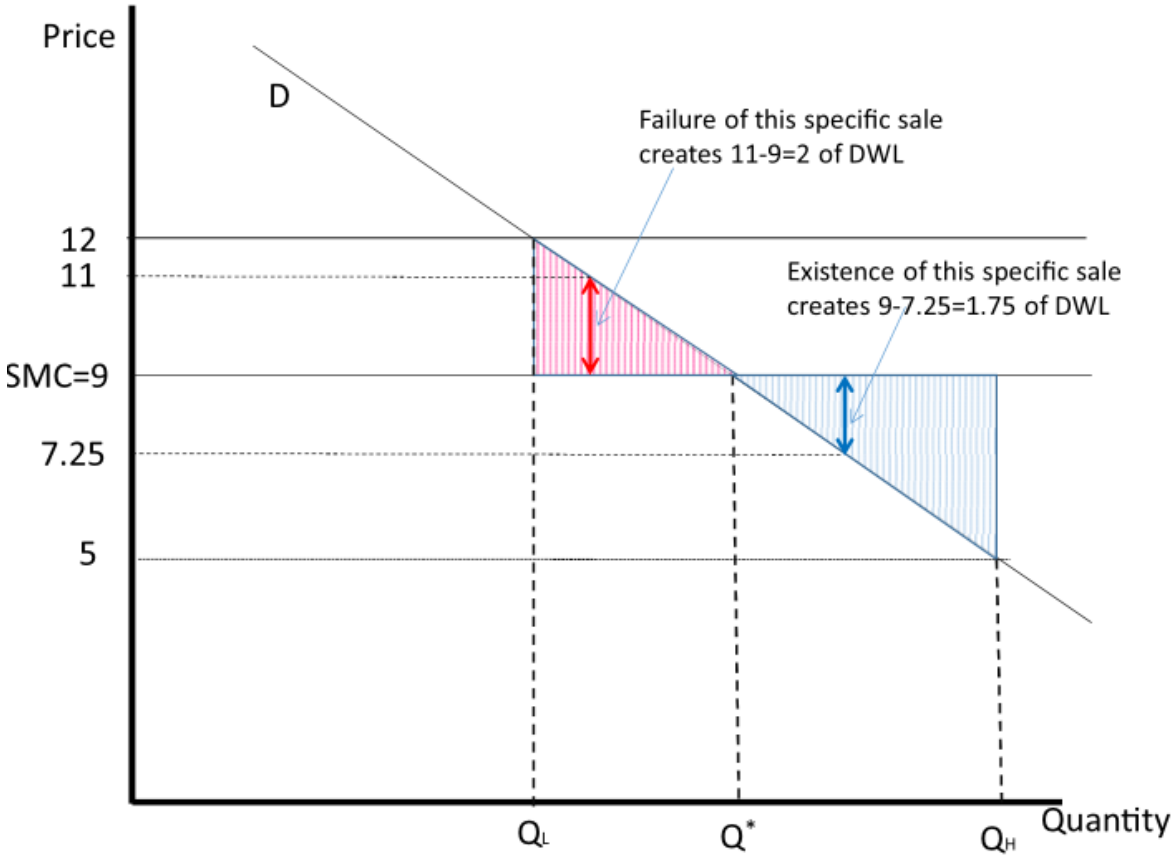
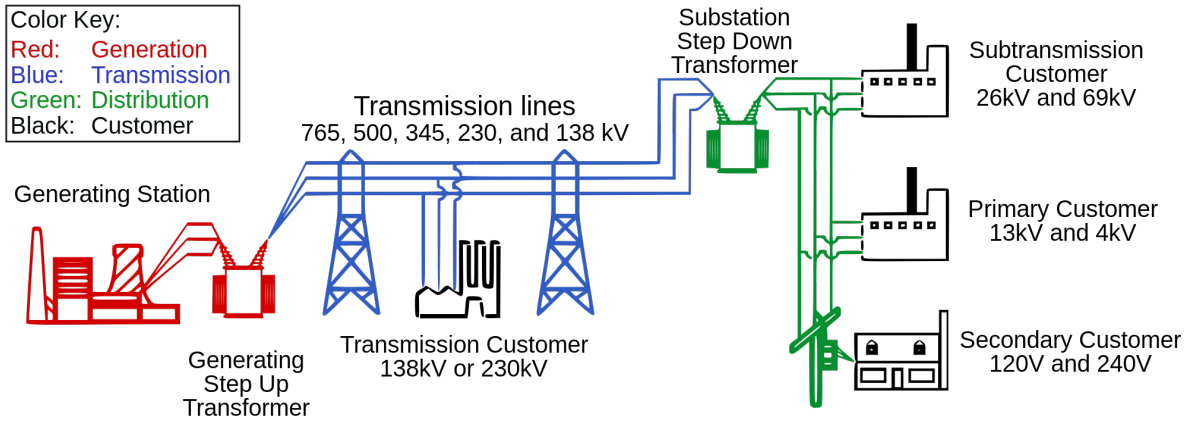
Two complications in electricity markets:

What are they?


Price
D
Failure of this specific sale
creates 11-9=2 of DWL
12
11
Existence of this specific sale
creates 9-7.25=1.75 of DWL
SMC=9
7.25
5
Q_L
Q^*
Q_H
Quantity

Recovering fixed costs

Overview of power system



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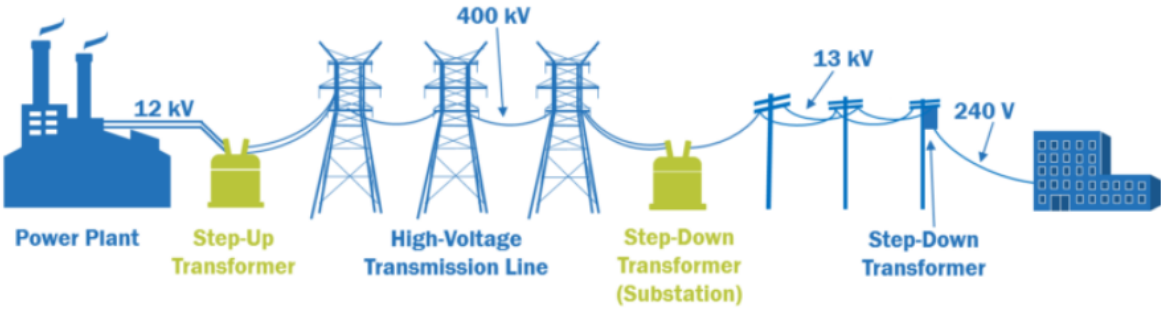
- What are **marginal** costs here?
- What are **fixed costs**?

Line losses

The Energy Information Administration estimates *about 5 percent* is lost nationally each year in transmission and distribution, most of which is in distribution.[1]



Source: Constellation

The quantity that is lost during transmission and distribution of electricity across the electric grid is referred to as a **line loss.** Because the utility provider must purchase enough energy to cover your estimated consumption (including line loss amount), this loss gets divided and passed on to customers.

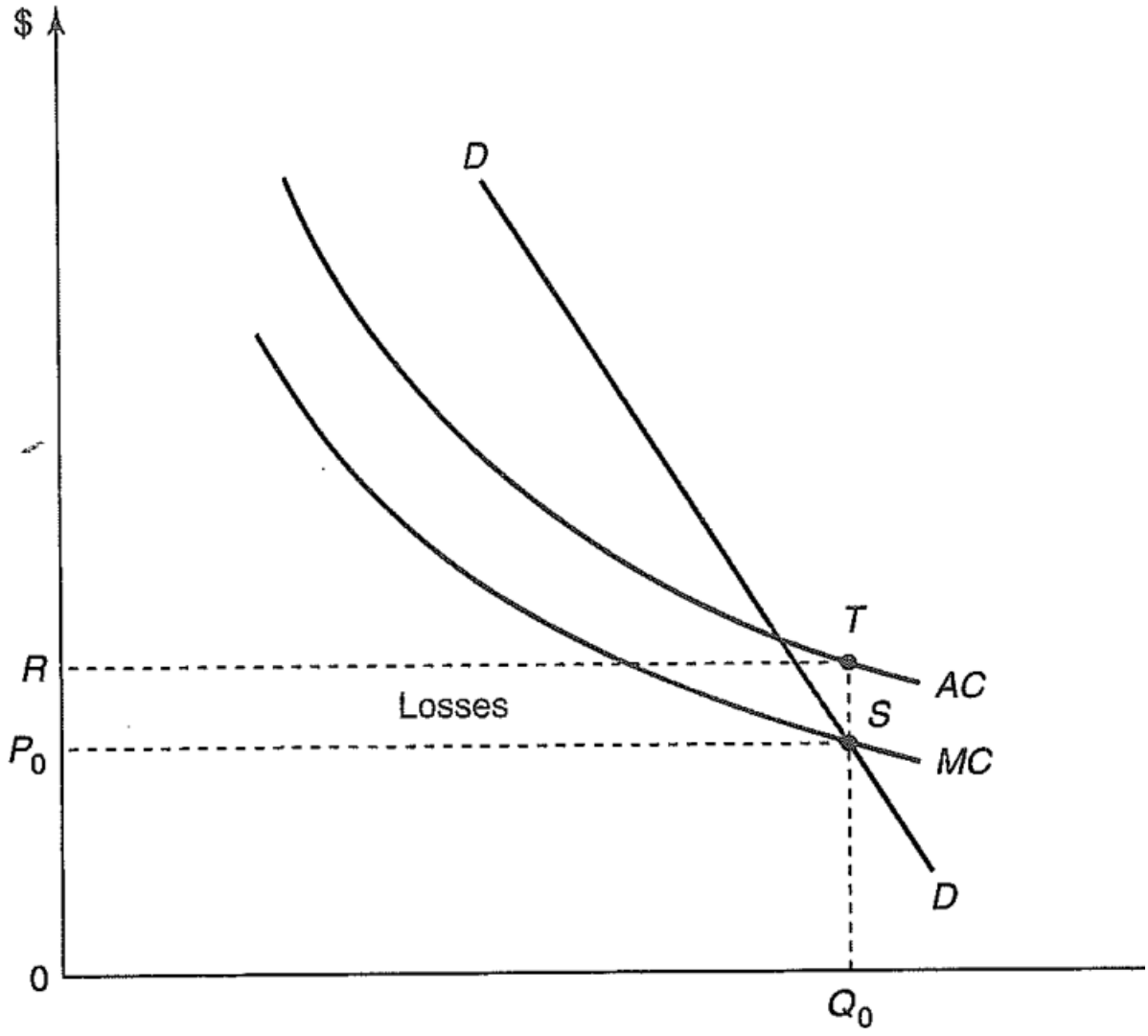
Cost breakdown

Marinal costs:

- cost of production
- *scarcity cost* if constrained
- line losses

Basically everything else is a **fixed cost**

Setting Price = MC generates losses



Most plans / utilities recover fixed charges on average

Total Charges for Electricity

Supplier (BILLING FOR CITY OF BOSTON CCE)		
Meter 2555879		
Generation Service Charge	453 kWh X .11161	$50.56
Subtotal Supplier Services		$50.56
Delivery		
(Rate A1 R1 RESIDENTIAL)		
Meter 2555879		
Customer Charge		$10.00
Distribution Charge	453 kWh X .08144	$36.89
Transition Charge	453 kWh X -.00411	-$1.86
Transmission Charge	453 kWh X .03812	$17.27
Revenue Decoupling Charge	453 kWh X .00304	$1.38
Distributed Solar Charge	453 kWh X .00469	$2.12
Renewable Energy Charge	453 kWh X .00050	$0.23
Energy Efficiency	453 kWh X .02254	$10.21
Subtotal Delivery Services		$76.24
Total Cost of Electricity		**$126.80**

More than half of the **marginal** price I pay covers non marginal costs.

. . .

This leads to innefficiently low consumption.

Ramsey pricing

If you must raise revenue from marginal pricing, its appealing to target taxes based on elasticity

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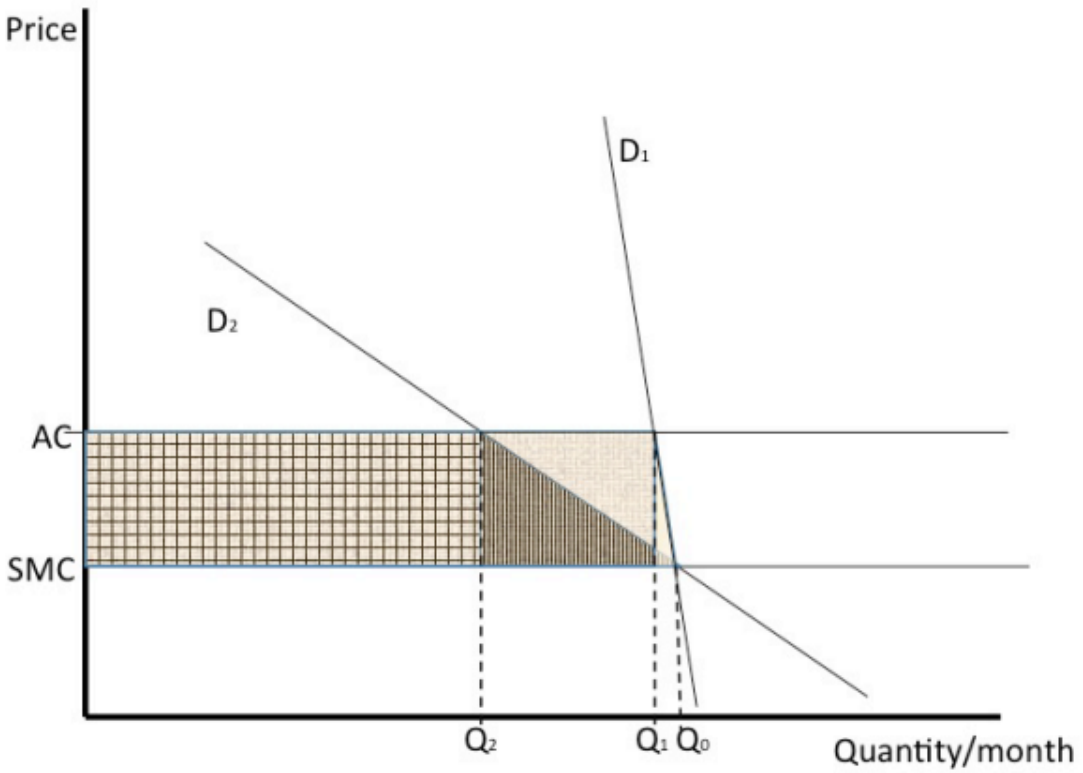


Figure 4.2. Illustration of the Impact of Demand Elasticity on DWL from Raising Price

- What groups do you think are more elastic?
- This is why commercial and industrial consumers often get lower marginal rates: They argue that they will move their business elsewhere.
- What do people think about this?

Theoretical best: Recover fixed costs with fixed charges

- Imagine I had to pay $50 each month just to get any electricity.
- But then only paid the true marginal cost for each kWh.
- That would restore efficiency on the margin, and avoid structural losses.

. . .

What are some concerns with this?

Problems with fixed charges

- Some consumers might leave the market
  - ie if I get less then $50 surplus
- Not equitable
  - Why should customers who use very little electricity pay an equal share of the system costs?
- Income concerns, conditional on usage

Fixed charge can be seen as very inefficient price for the first unit

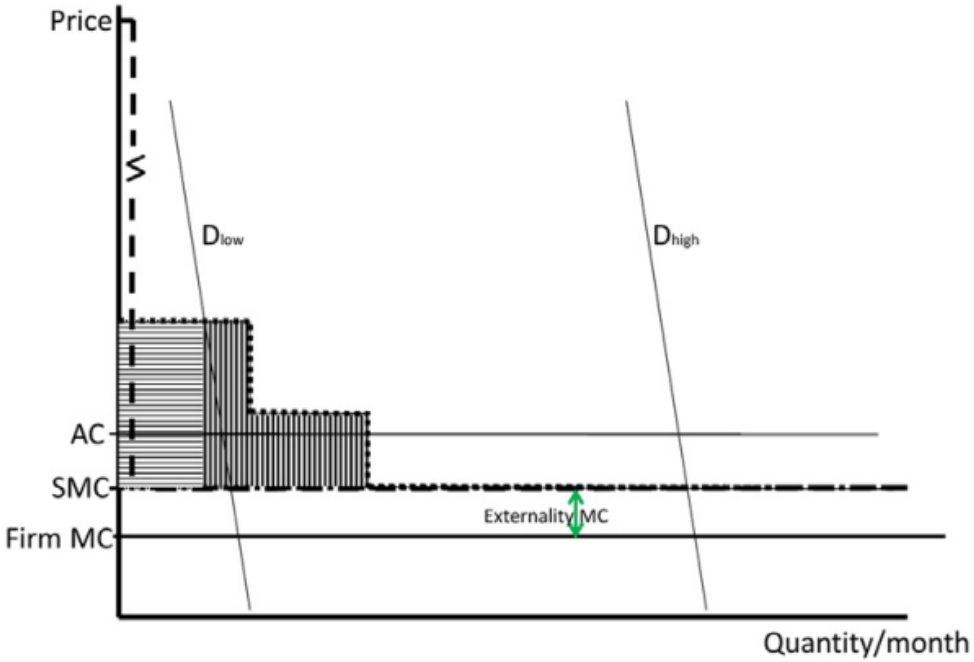
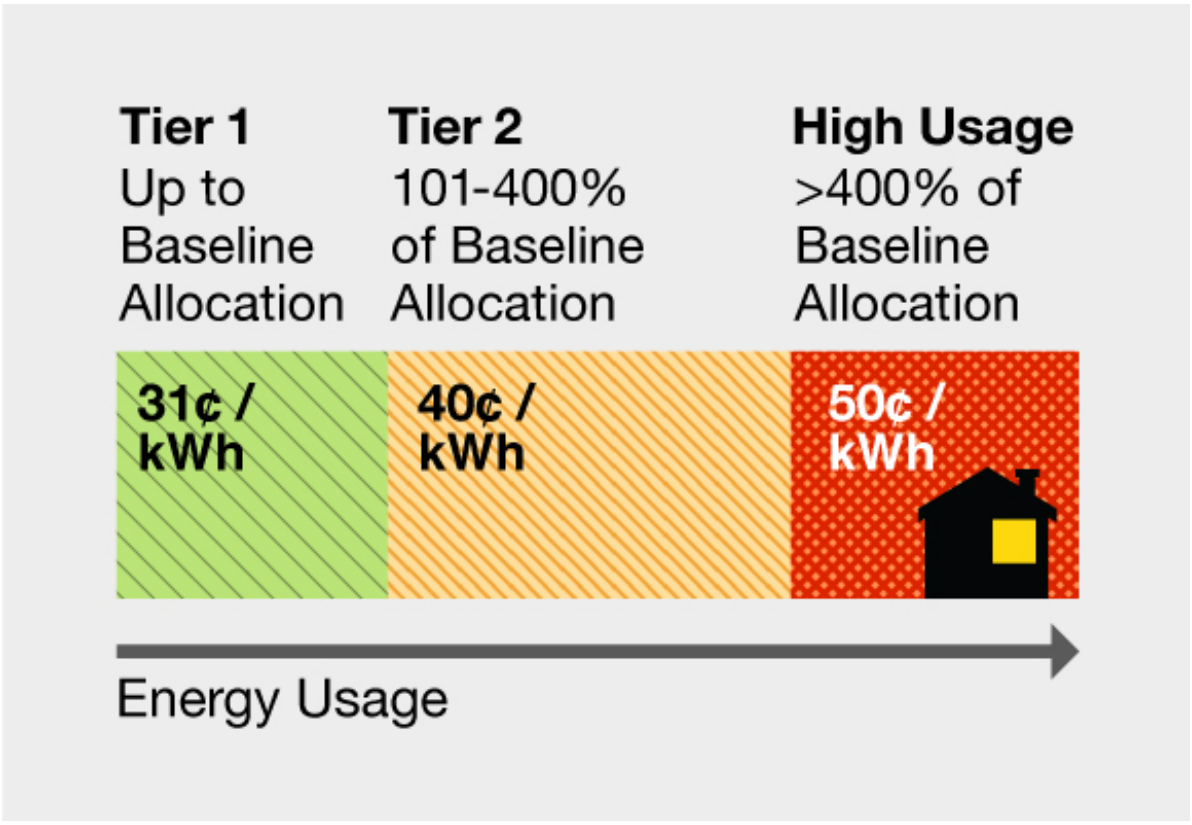


Fig. 3. From Fixed Charges to Decreasing-Block Pricing to Flat Rates.

Decreasing block prices rarely observed. But *increasing* prices often are

Example from SoCal Gas & Electric.



Why do you think some utilities setup prices this way?

What about a minimum bill?

A minimum bill is a combination of a fixed charge and a certain quantity of free electricity.

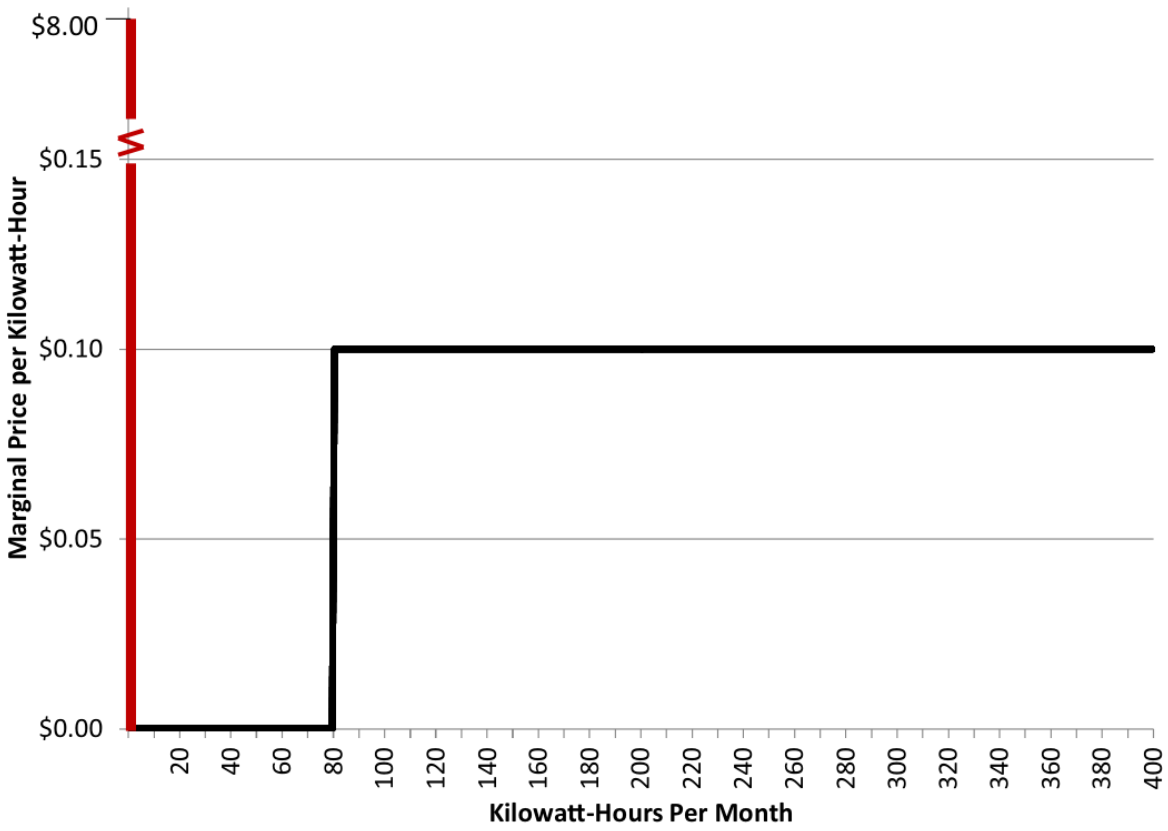


Illustration of Rate Structure with Minimum Bill (Min Bill $8, p=$0.10/kWh)

- Example:
  - P = $0.10/ kWh
  - min bill = $8/ month
- Identical to a fixed charge of $8 per month plus receiving the first 80 kWh for free.
- What are some concerns with this?

Problem with min bills

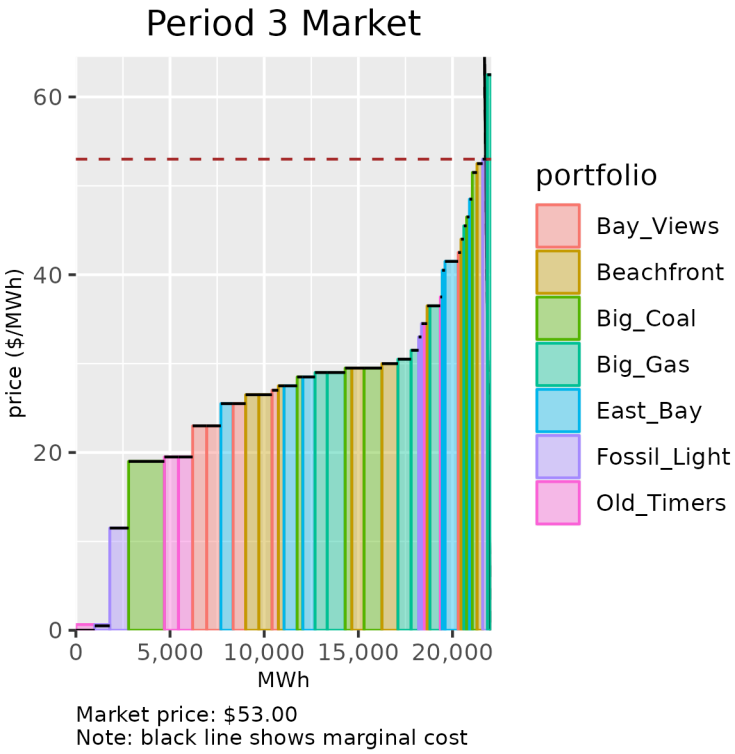
Problem: Until you hit the min, you have **zero** mc of consumption.

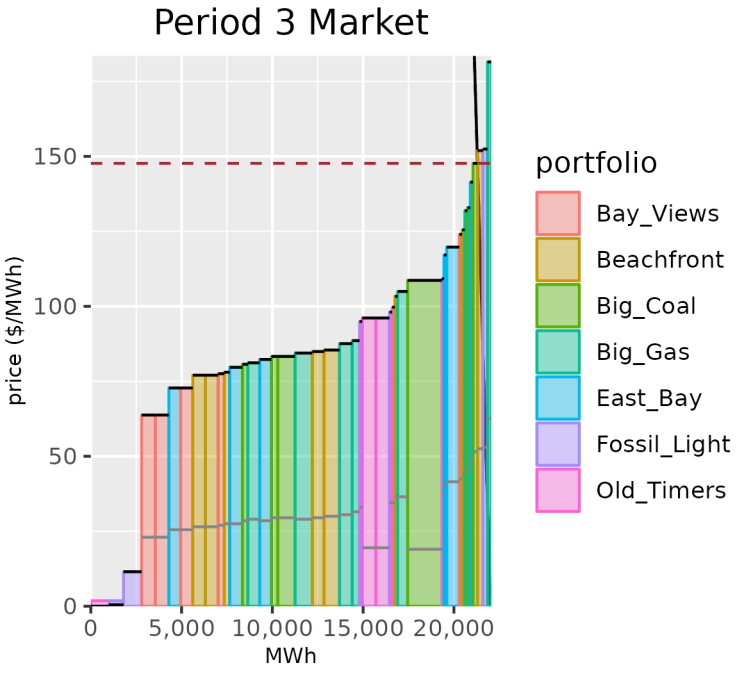
But marginal costs are not zero!

External costs

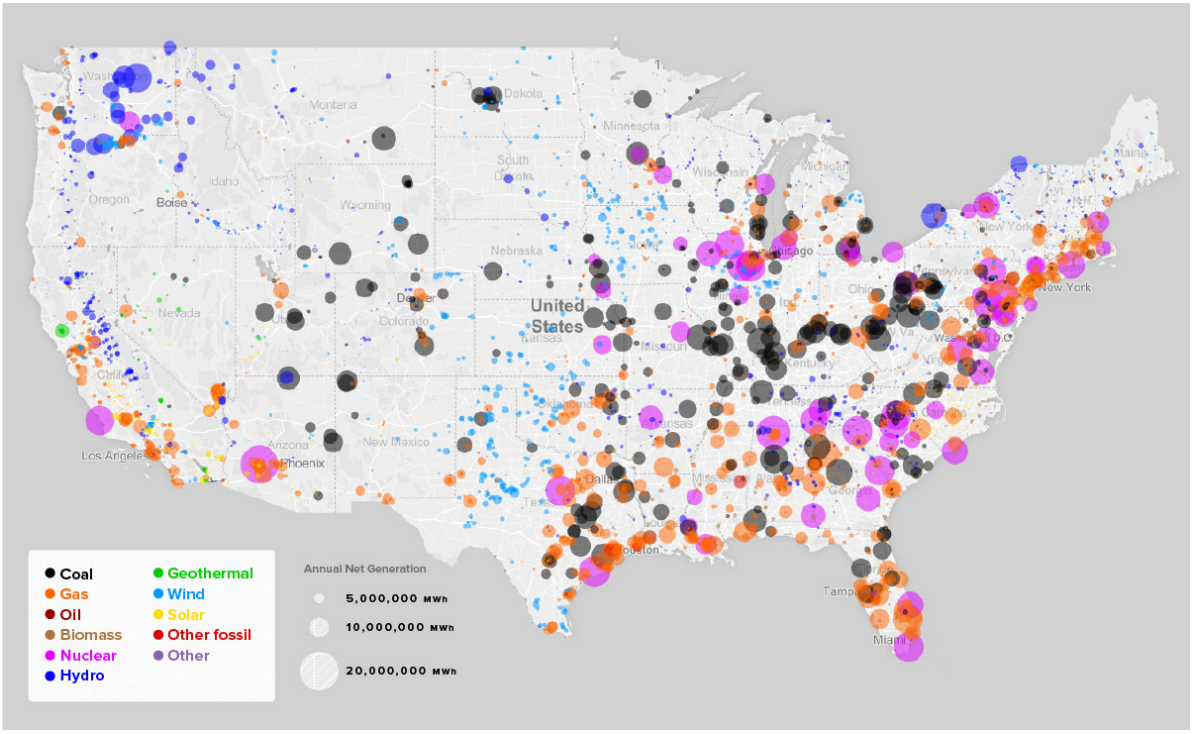
Previous section just considered *private* marginal costs.

- Electricity production causes large **social costs** (on the margin) as well.
  - Local air pollution: PM, ozone, etc
  - Climate externality: C02
- Since these are generally unpriced, all else equal, consumer prices are **too low**



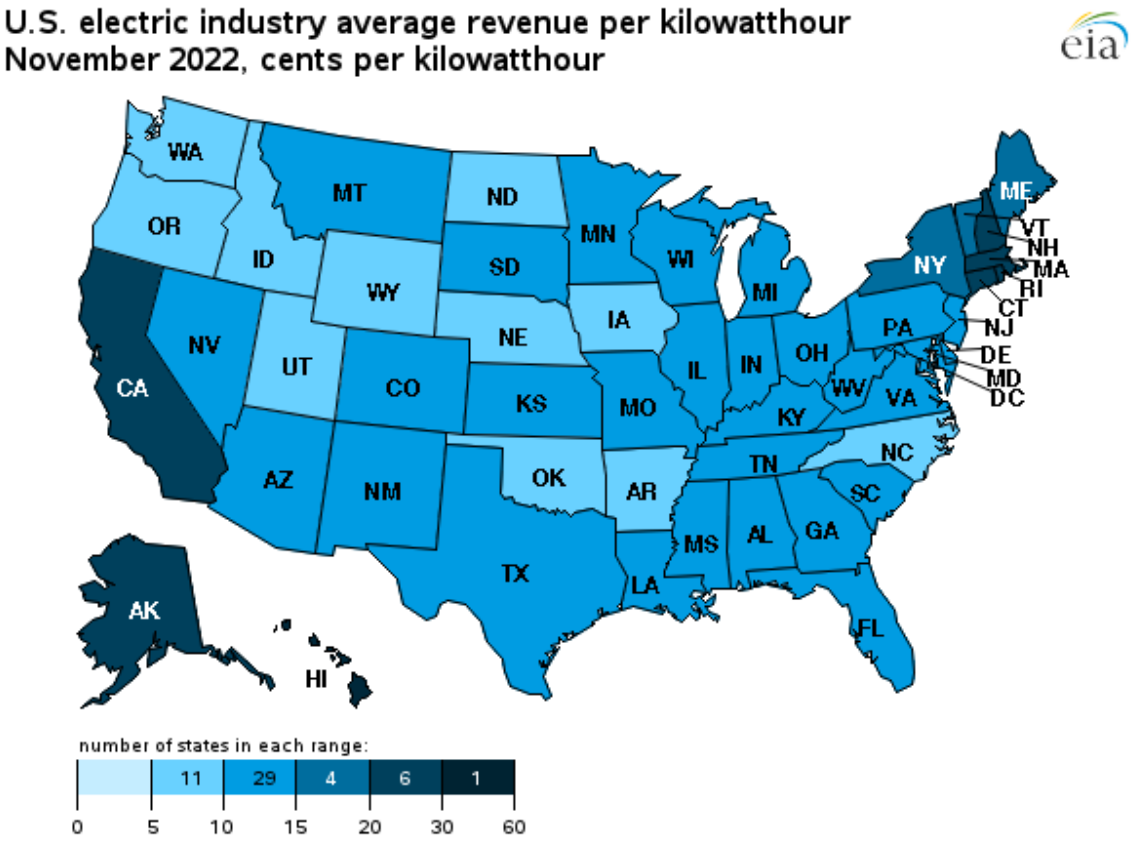


Market price: $147.67
Note: black marginal cost line assumes carbon price of $163
Note: grey marginal cost line assumes carbon price of $0


Coal
Gas
Oil
Biomass
Nuclear
Hydro
Geothermal
Wind
Solar
Other fossil
Other
Annual Net Generation
5,000,000 MWh
10,000,000 MWh
20,000,000 MWh
United States
Montana
Idaho
Oregon
Boise
Wyoming
Nebraska
Colorado
Denver
Nevada
Arizona
New Mexico
Phoenix
Los Angeles
Minnesota
Chicago
New York
Miami

Evidence

Are prices too low? Too high?



Borenstein and Bushnell (2022): Both

Do Two Electricity Pricing Wrongs Make a Right? Cost Recovery, Externalities, and Efficiency†

By Severin Borenstein and James B. Bushnell*

Economists favor pricing pollution in part so that consumers face the full social marginal cost (SMC) of goods and services. But even absent externalities, retail electricity prices typically exceed private marginal cost, due to a utility's need to cover average costs. Furthermore, the SMC of electricity can fluctuate widely hour-to-hour, while retail prices do not. We show that residential electricity rates exceed average SMC in most of the US, but there is large geographic and temporal variation. This finding has important implications for pass-through of pollution costs, as well as for policies promoting dynamic pricing, alternative energy, and reduced electricity consumption. (*JEL* D62, L94, L98, Q42, Q53)

B&B look at data from 2014-2016

Table 1—Summary Statistics of Residential Rates

	Mean	SD	Min	P10	P90	Max
Retail fixed charge ($/month)	10.78	7.65	−26.11	2.53	20.00	75.53
Retail variable price (¢/kWh)	11.49	3.07	2.36	8.79	16.29	48.22
Retail average price (¢/kWh)	12.61	3.01	2.96	9.83	16.65	53.31

Notes: $N = 6{,}215$ (utility-state-years). Statistics are sales-weighted.

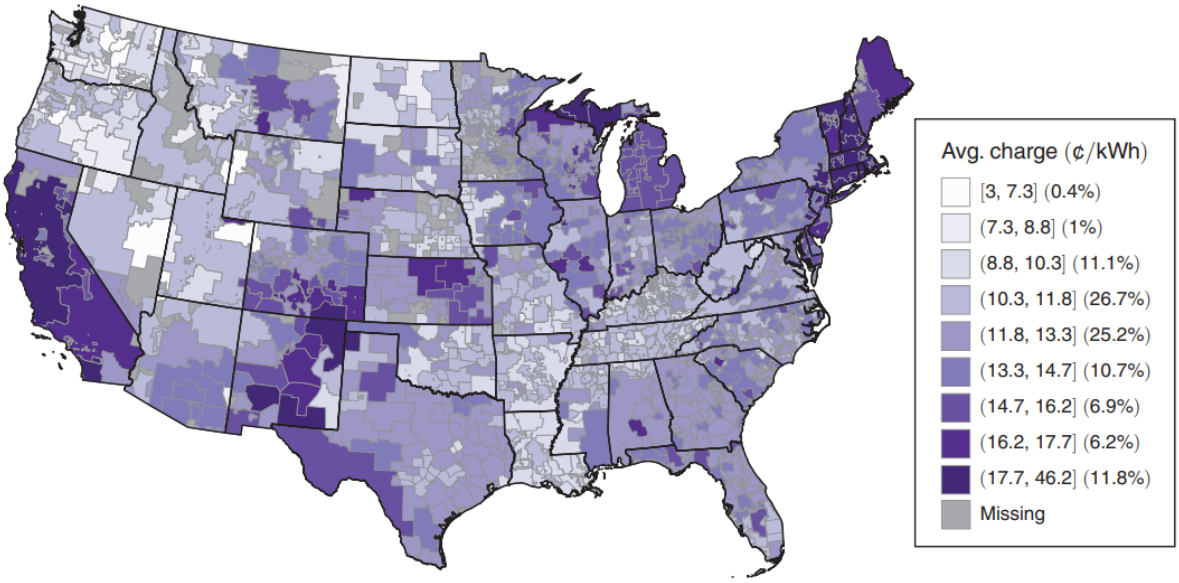


FIGURE 1. AVERAGE PRICE PER KILOWATT-HOUR

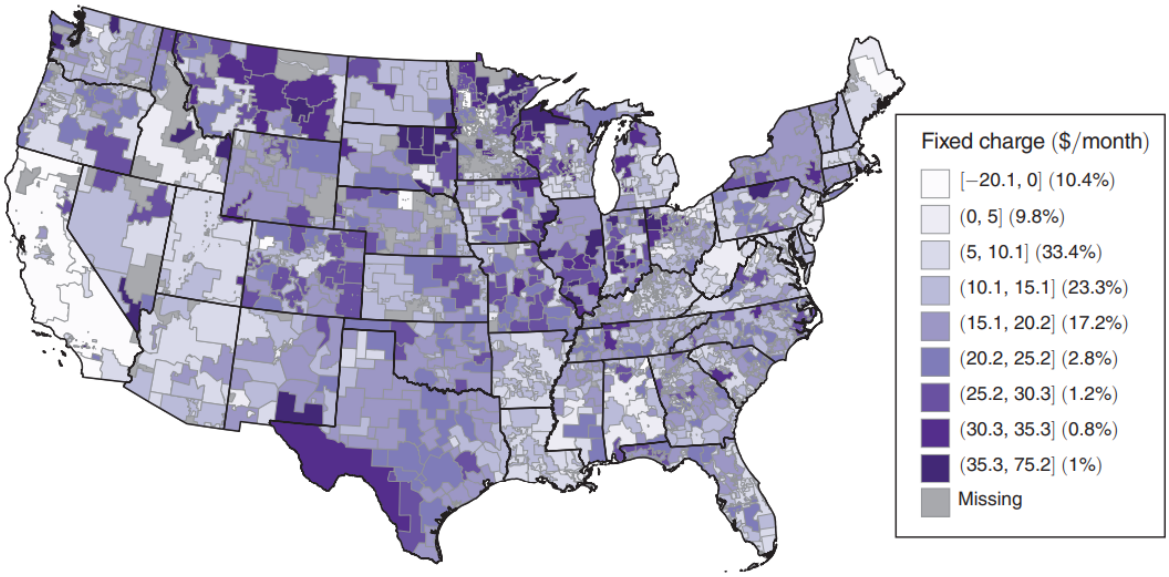


FIGURE 2. FIXED MONTHLY CHARGE

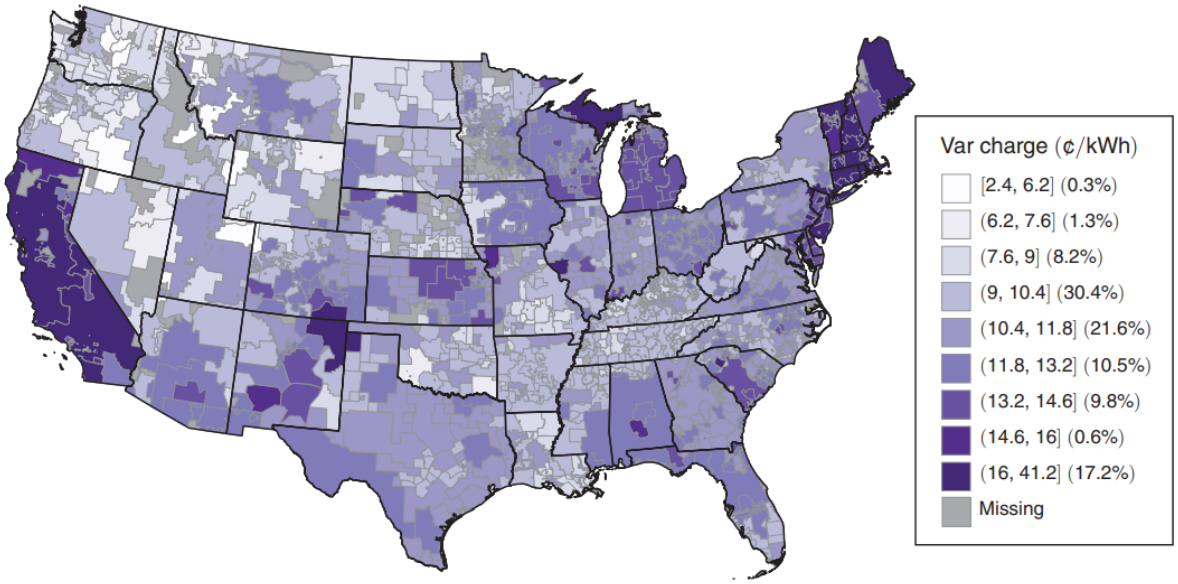
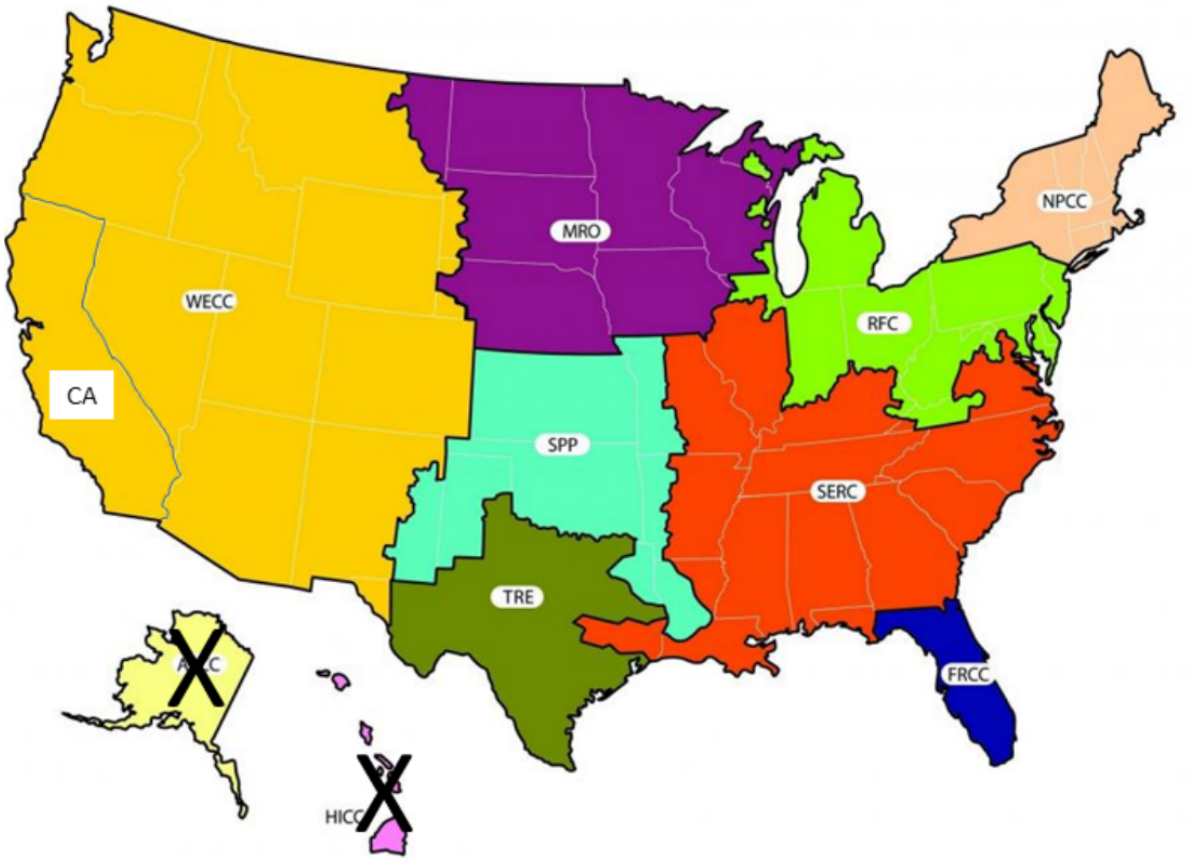


FIGURE 3. MARGINAL PRICE PER KILOWATT-HOUR

Summarize wholesale prices at NERC region



Avg wholesale prices *much* lower than avg retail rates

TABLE 2—WHOLESALE POWER PRICES BY NERC REGION (¢/KWH)

Region	Location	Mean	Min	P10	P90	Max
CA	California	3.39	−15.00	1.75	5.24	165.89
FRCC	Florida	2.59	−3.27	1.59	3.73	104.32
MRO	Upper Midwest	2.59	−15.00	1.34	3.89	185.82
NPCC	Northeast	4.10	−15.00	1.33	7.62	144.61
RFC	Great Lakes	3.49	−15.00	1.80	5.27	193.88
SERC	Southeast	3.06	−15.00	1.71	4.18	272.68
SPP	Oklahoma/TX	2.71	−15.00	1.50	3.84	465.59
TRE	Texas	2.82	−11.04	1.52	4.02	470.84
WECC	Non-CA West	3.09	−15.00	1.53	4.81	277.03

Note: Weighted by retail sales.

Avg line losses $\sim$ 7%; *Marginal* losses are larger

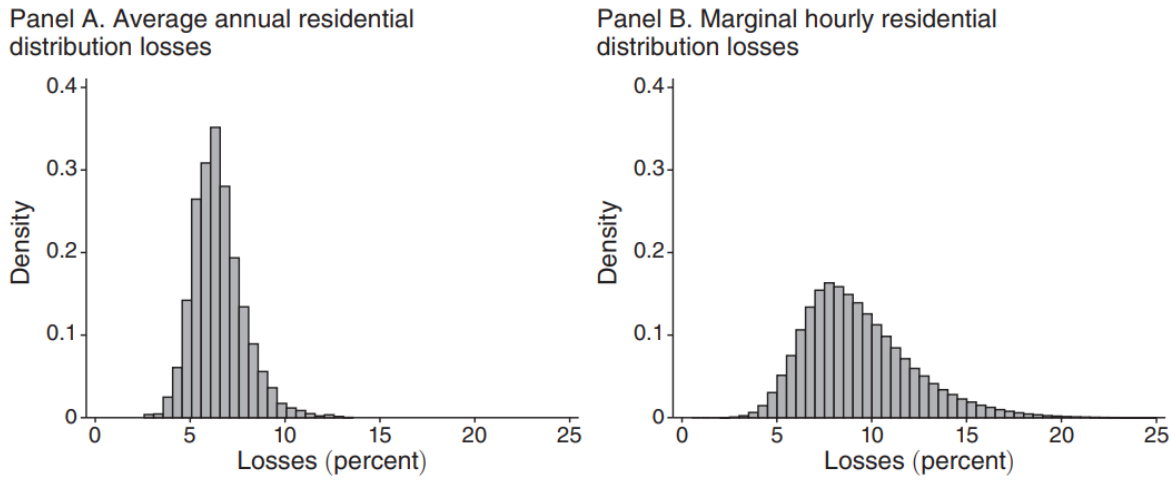


FIGURE 4. ESTIMATES OF RESIDENTIAL DISTRIBUTION LOSSES

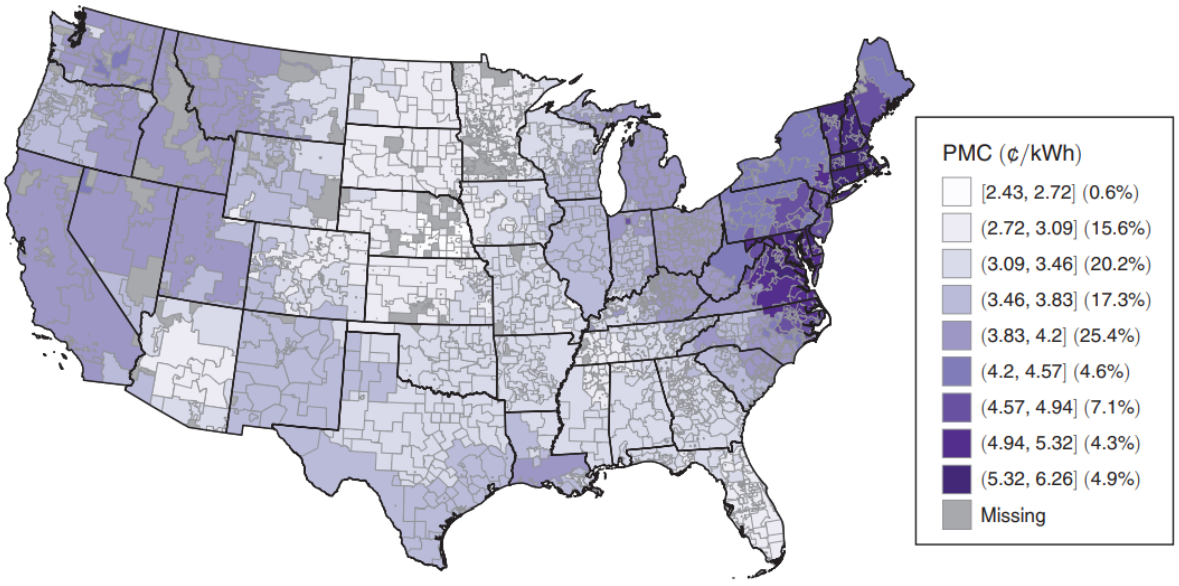


FIGURE 5. AVERAGE PRIVATE MARGINAL COST PER KILOWATT-HOUR

Estimating external costs

- For each of the four major pollutants from electricity generation (CO2, SO2, NOx, and PM2.5), create a variable that is total emissions damages by hour of the three-year sample for each of the nine regions, incorporating the operations of each fossil fuel power plant and the damages associated with emissions from each plant
- To map local damages to money, use a widely used model (AP3)
- Assume social cost of carbon of $50/ton
  - This is too low now
- Run hourly regressions to translate these *average* emissions into *marginal* costs associate with consumption in each utlity.

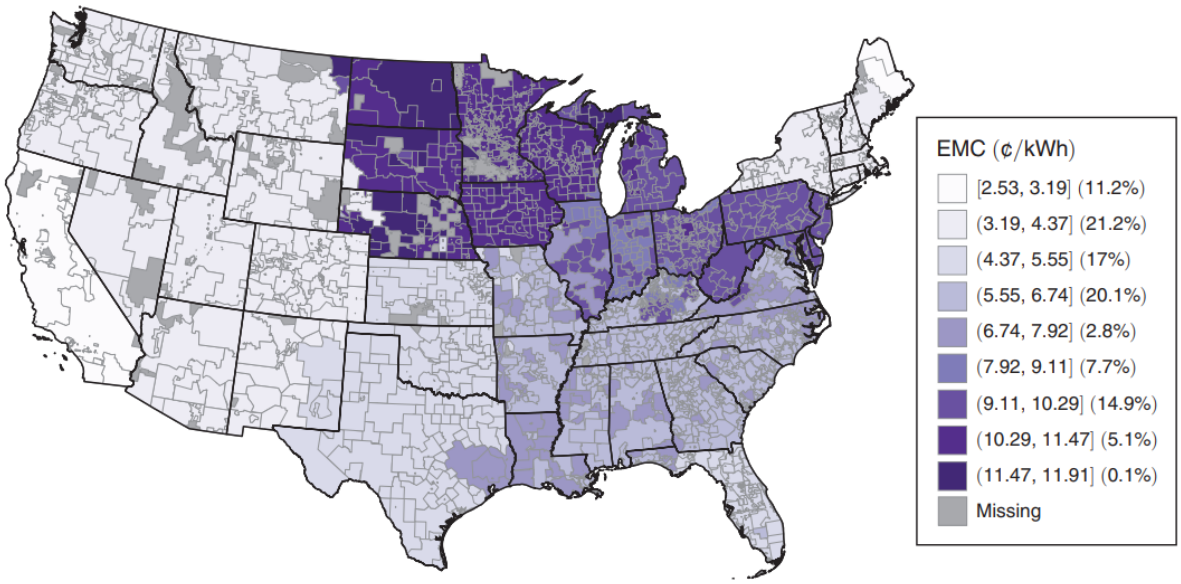


FIGURE 7. AVERAGE EXTERNAL MARGINAL COST PER KILOWATT-HOUR

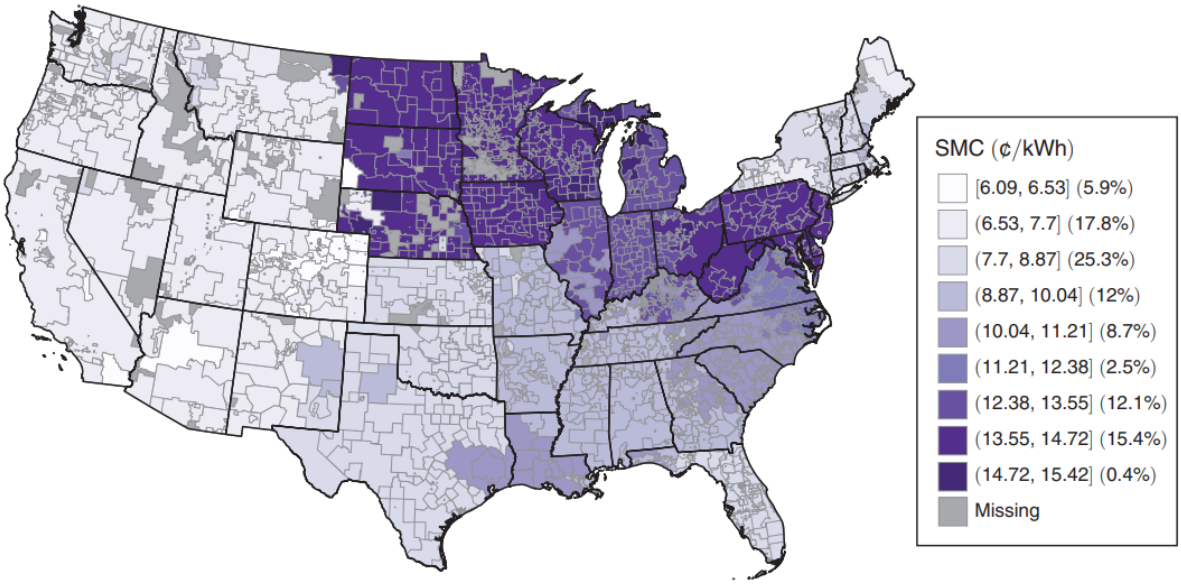


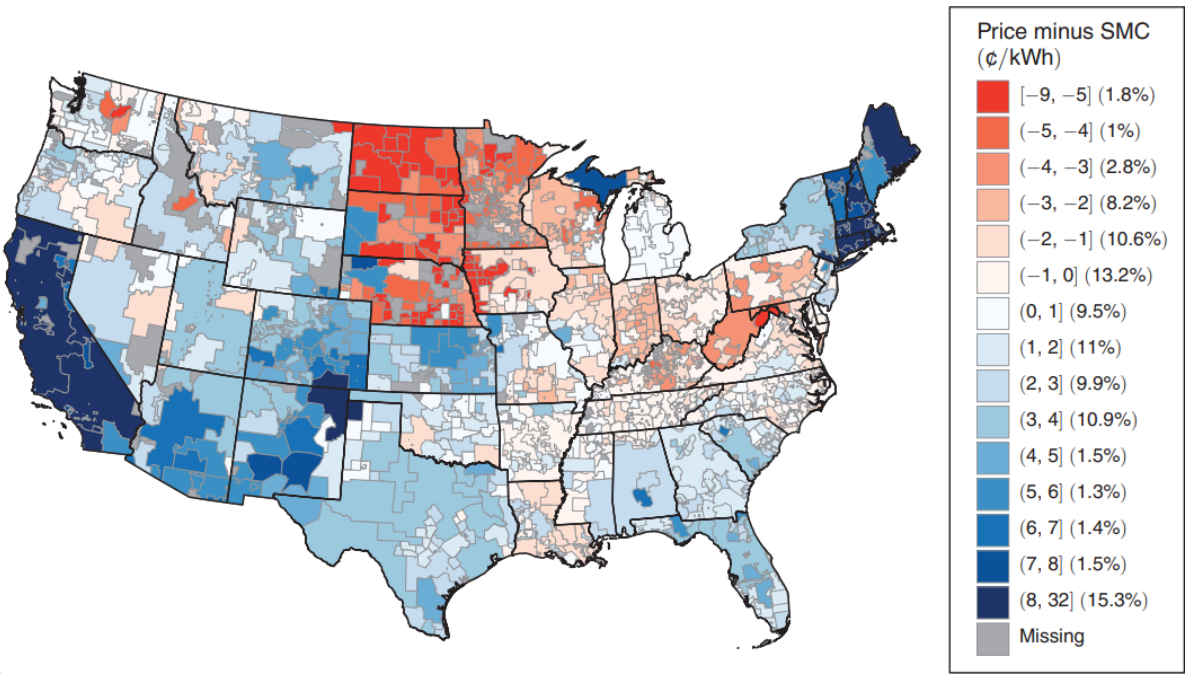
FIGURE 8. AVERAGE SOCIAL MARGINAL COST PER KILOWATT-HOUR

TABLE 5—ANNUAL AVERAGES OF PRICES AND MARGINAL COSTS

	Mean	SD	Min	P10	P90	Max
Retail variable price (P, ¢/kWh)	11.49	3.07	2.36	8.79	16.29	48.22
Private marginal cost (¢/kWh)	3.72	1.15	2.16	2.59	5.10	8.22
External marginal cost (¢/kWh)	6.21	2.38	2.50	3.04	9.38	12.12
Social marginal cost (SMC, ¢/kWh)	9.93	2.67	5.14	6.51	13.72	17.71
P–SMC (¢/kWh)	1.56	4.21	−9.39	−2.82	6.74	35.89
(P–SMC)/P	0.08	0.31	−3.47	−0.28	0.51	0.81

Notes: $N = 6{,}215$ (utility-state-years). Statistics are sales-weighted. Each observation is the hourly sales-weighted average value of the variable for a utility-state-year. These summary statistics are weighted across observations by the utility-state annual sales.

- on average prices are **too high** ($\sim 8\%$)
- but in many places they are far **too low**


Price minus SMC
(¢/kWh)
[−9, −5] (1.8%)
(−5, −4] (1%)
(−4, −3] (2.8%)
(−3, −2] (8.2%)
(−2, −1] (10.6%)
(−1, 0] (13.2%)
(0, 1] (9.5%)
(1, 2] (11%)
(2, 3] (9.9%)
(3, 4] (10.9%)
(4, 5] (1.5%)
(5, 6] (1.3%)
(6, 7] (1.4%)
(7, 8] (1.5%)
(8, 32] (15.3%)
Missing

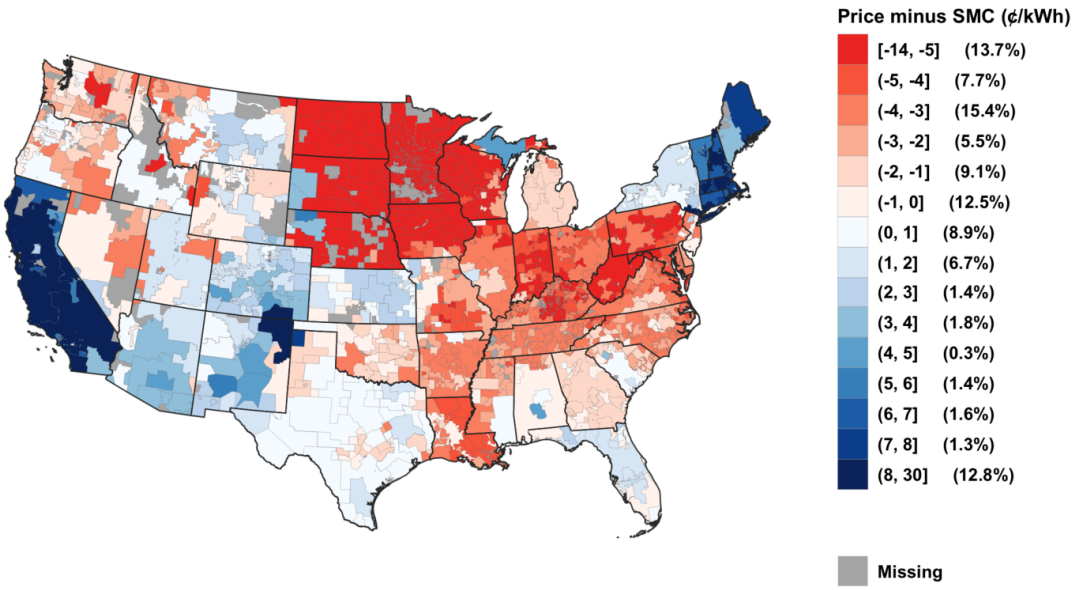


Figure A3: Marginal Price minus Average SMC per kWh with SCC=$100/ton

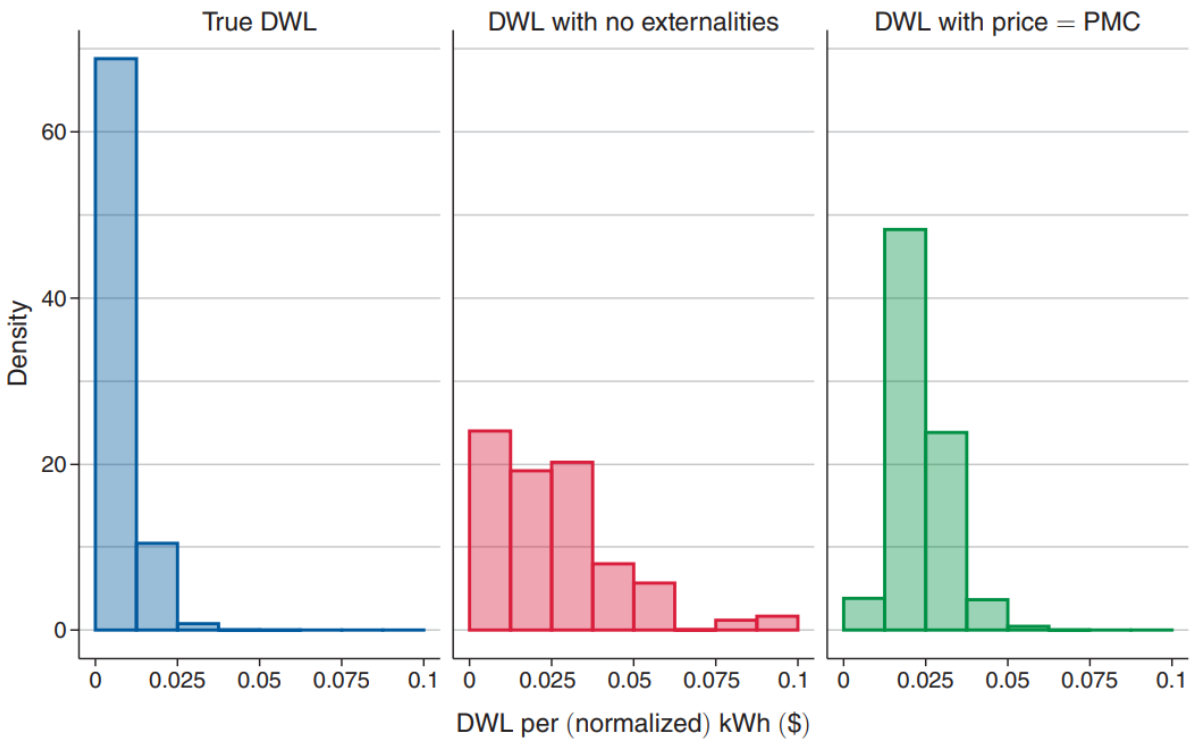


FIGURE 13. DISTRIBUTION OF DWL PER NORMALIZED KILOWATT-HOUR WITH ONE OR BOTH PRICING WRONGS

Four Fundamental Goals of Rate Design

(from Severin Borenstein)

- Economic Efficiency of Consumption: encouraging additional usage when – and only when – it is valued more than the full additional cost to society
- Equity: distributing costs among customers in a way that is consistent with societal views of fairness
- Ensuring Access: creating rates that ensure that all members of society are able to consume quantities necessary for basic needs
- Cost Recovery: allowing suppliers to recover costs, including the opportunity cost of capital