ECONOMIC FUNDAMENTALS
OF REGULATION

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About your speaker

- Geoff Marke, PhD
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- Consumer Advocate Office for ratepayers in:
  - Vertically integrated electric, natural gas, water and sewer cases before the Missouri Public Service Commission
- Comments and work product are authors own and do not necessarily reflect the position of the Missouri OPC.

Course Objectives

- Audience should:
  - Be comfortable with the fundamental economic underpinnings of utility regulation with examples illustrating the rationale and inherent challenges of mitigating “market and monopoly failure”
  - Reinforce a generalist knowledge of the subject to complement your professional skills
  - Work towards being “less wrong”

Goal: Less Wrong

- The “central, continuing responsibility of legislatures and regulatory commissions is finding the best possible mix of inevitably imperfect regulation and inevitably imperfect competition.”

Economist, Alfred Kahn

Regulation can be controversial

- Conflicting ideas of right and wrong
- Differing ideas of the role of government
- Complexity of problems (2nd and 3rd order impacts)
- Challenges inherent in implementing policy
- Response time in face of challenges
- Lack of clarity between political and technical aspects of regulation
- Special interests and collective action problems

- What are the regulatory tools to address these controversies?

Policy Instruments

- Carrots can come with strings attached;
- Sticks can be actively sought after;
- Information can vary

Theory & Perspectives

- **Positive statements**

  are objective statements that can be tested, amended or rejected by referring to the available evidence. It looks at the world as it is.

- **Normative Statements**

  expresses a value judgment about whether a situation is desirable or undesirable. It looks at the world as it "should“ be.

Economic Regulation

- Government regulation of business practices, industry rates, or areas serviced by particular industries.
- Oldest form of public control. Developed from the efforts of municipalities, state legislatures, and the federal government to regulate firms in transportation, energy, communication, railroads, trucking, etc… to minimize market failure

Social Regulation

- Governmental regulation of the quality and safety of products as well as the conditions under which goods and services are produced.
- Greatly expanded use of regulation in 1960s and 70s to control products, contaminants, pollutants, and working conditions to protect health, safety and the environment

Economics

- Economics is the study of how to deal with the problem of scarcity. Economic systems seek to allocate scarce resources between society's competing wants and needs.

- Behind this definition are two key ideas in economics:

    1. that goods are scarce; and

    2. that society must use its resources efficiently.

- Economic Efficiency = the condition whereby a society gets the highest social welfare from its scarce resources.

- The ultimate goal of economic science is to improve the living conditions of people in their everyday lives.

- Economic regulation may sacrifice efficiency to achieve other goals

Theoretical Perspective(s) of Economic Regulation

- **Public Interest Theory:**

Regulation is supplied in response to the demand of the public for the correction of inefficient or inequitable market practices. (extreme = benevolent social planner)

- **Private Interest (or Public Choice) Theory:**

Regulation is supplied in response to the demands of interest groups struggling among themselves to maximize the incomes of their members. (extreme = regulatory capture)

What do ideal competitive markets look like?

- Many buyers and sellers
- Easy entry and exit
- Transparent information
- Absence of price control and collusion
- Creative Destruction

Traditional Economic Theory

- Examines the cause and effect relationships between market structure and economic performance.
- If a market is competitive (i.e., “many firms”), individual firms are forced to:

1. Charge a price equal to the marginal cost of production
2. Operate in a technically efficient manner
3. Be guided by consumer demand in determining how much and what products need producing. (consumer sovereignty)

- If it falls short—it goes out of business

- Competitive market structures suggest that the more competition there is, the more likely firms will be efficient and prices low.

How are utilities different?

- Market Failure – no competition (which they want)
- Natural Monopoly – scale economies and lumpy investments
- Essential Services
- Captive customers
- Regulatory oversight
- Largely inelastic demand (short-term)

- Tolstoy opens Anna Karenina by observing that,

  “All happy families are alike; each unhappy family is unhappy in its own way.”

  Business is the opposite.

  All happy companies are different: each one earns a monopoly by solving a unique problem. All failed companies are the same: they failed to escape competition.

  Peter Thiel, “Zero to One”

- For utilities, the state supplies the regulatory risk in the absence of market risk—**economic regulation is a proxy for the market**

- Regulation exists due to market failure and in turn must prevent regulatory failure (i.e., costs exceeding benefits)

- Utilities that operate under rate-of-return regulation have low business risk because of the strength of the regulatory compact.

- Utilities operating under the compact are not supposed to be shielded from all economic or business risks nor denied the rewards that come with effective risk management

- See also why regulatory lag

Appropriate Regulatory Compact Balance

Regulators

Consumers

- Safe and Reliable Service
- Affordability

Utilities

- Right to Reasonable Return
- Timely recovery of costs

Concentration in market powers…

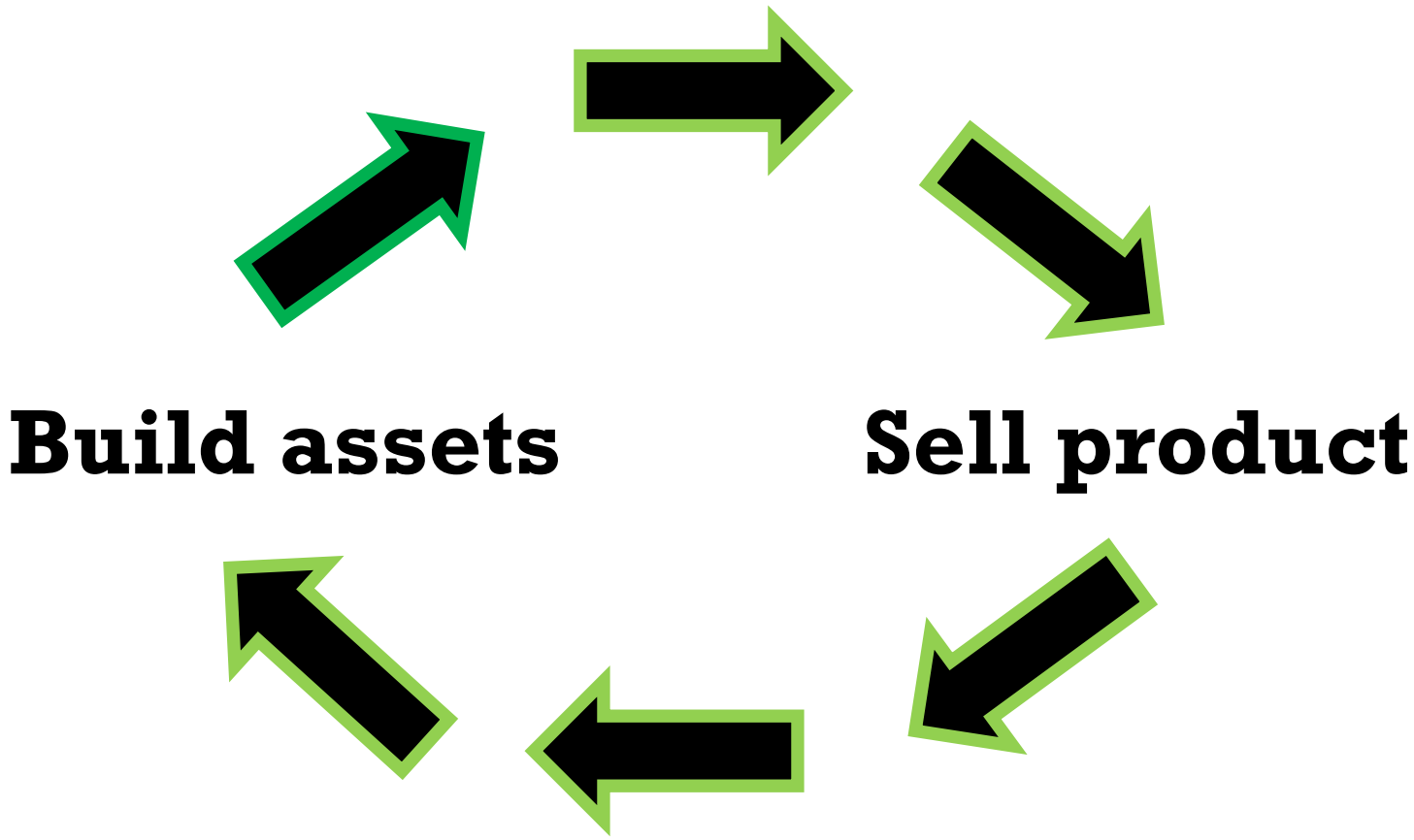
- **Three companies control** about 80% of mobile telecoms. Three have 95% of credit cards. Four have 70% of airline flights within America. Google handles 60% of search. The list goes on (*The Economist*).

- **In agriculture,** four companies control 66% of U.S. hogs slaughtered in 2015, 85% of the steer, and half the chickens, according to the Department of Agriculture (*Open Markets Institute*).

- **Similarly, just four companies control** 85% of U.S. corn seed sales, up from 60% in 2000, and 75% of soy bean seed (*US Department of Agriculture*).

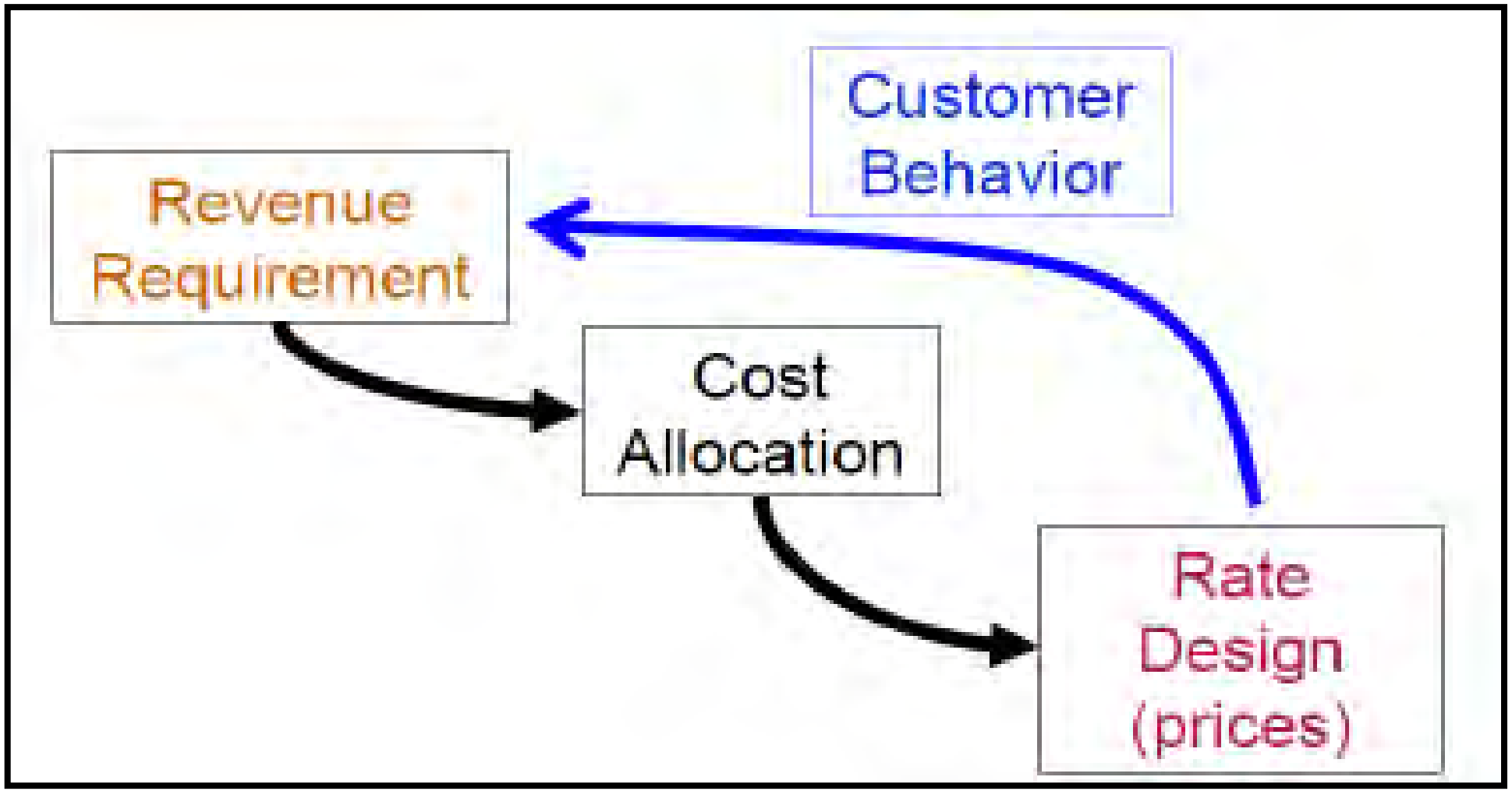
Economic Regulation and Principles

How do utilities make money?



Rate of return regulation

The Feedback Loop



- Economists see regulation as a means to exploit economies of scale from natural monopolies while reducing economic loss in markets with imperfections.

- Absent regulation, those imperfections can lead to problems:
  1. destructive competition;
  2. unanticipated scarcity;
  3. insufficient innovation;
  4. negative externalities; and
  5. the “deadweight” economic loss that results when demand and supply curves intersect sub optimally.

Regulatory principles at work: Prudence Test

- Were the costs reasonable at the time they were incurred given the circumstances and what was known or knowable at the time?

- It is commonly used as an oversight tool by the government to ensure that money invested into a project is being spent as it was intended and investors have a fair opportunity to receive a return.

- Regulators can consider cases of hidden imprudence, but are required to consider what was known or knowable at the time the decision was made by the PSC.

Prudent Investment Principle

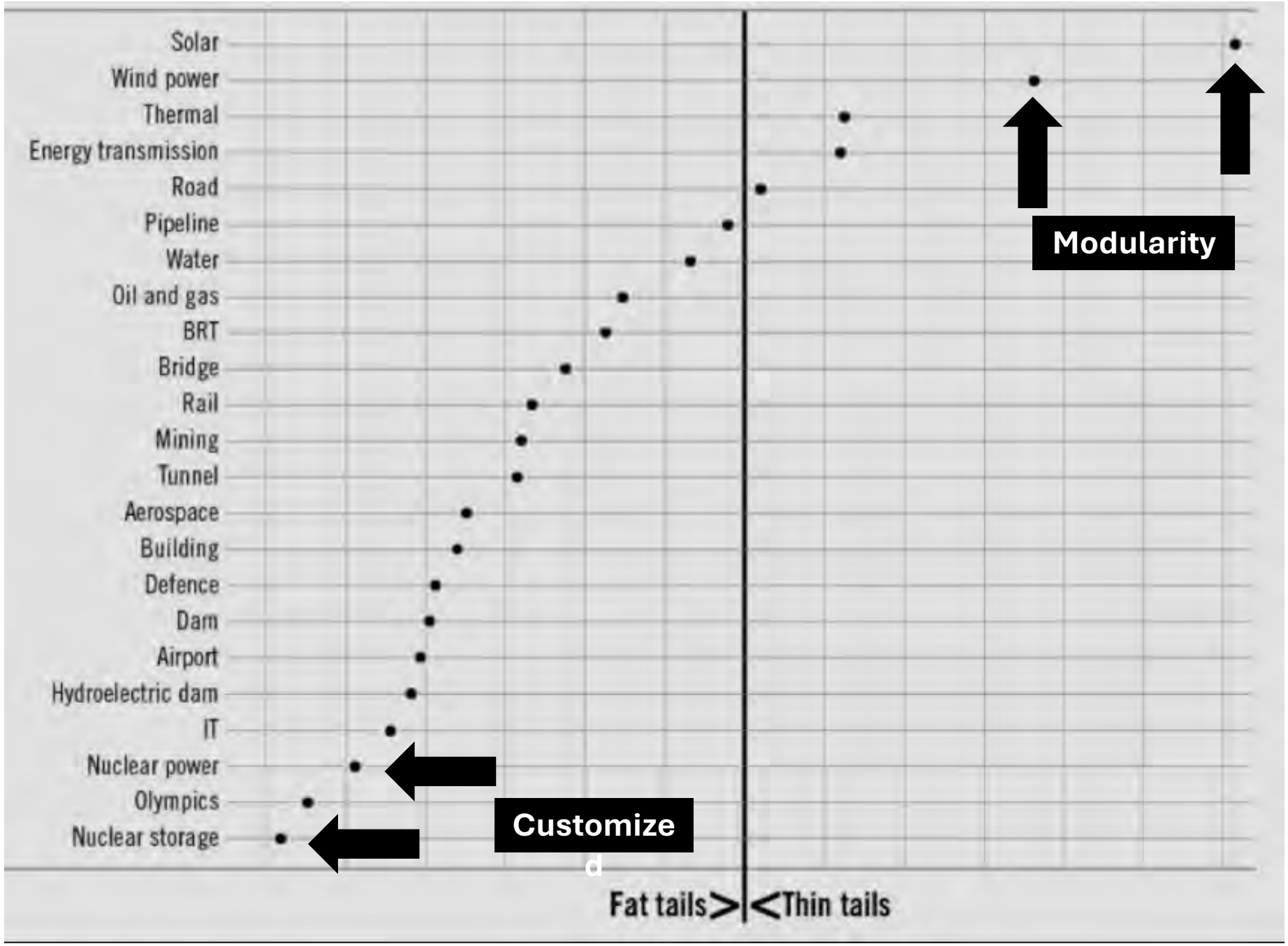
- In deciding whether an investment was prudent, there are two, sometimes three questions to be answered.

- 1.) Was the initial decision to move forward prudent?
  - Pre-approval? IRP? Other?

- 2.) Was the actual construction work handled in a prudent manner?
  - On-time and on-budget? Contracts and competitive bidding? Management discretion?

- 3.) If it later became necessary to cancel a partially completed project, was the decision to stop construction made in a timely manner?
  - Who pays? Used and Useful principle?

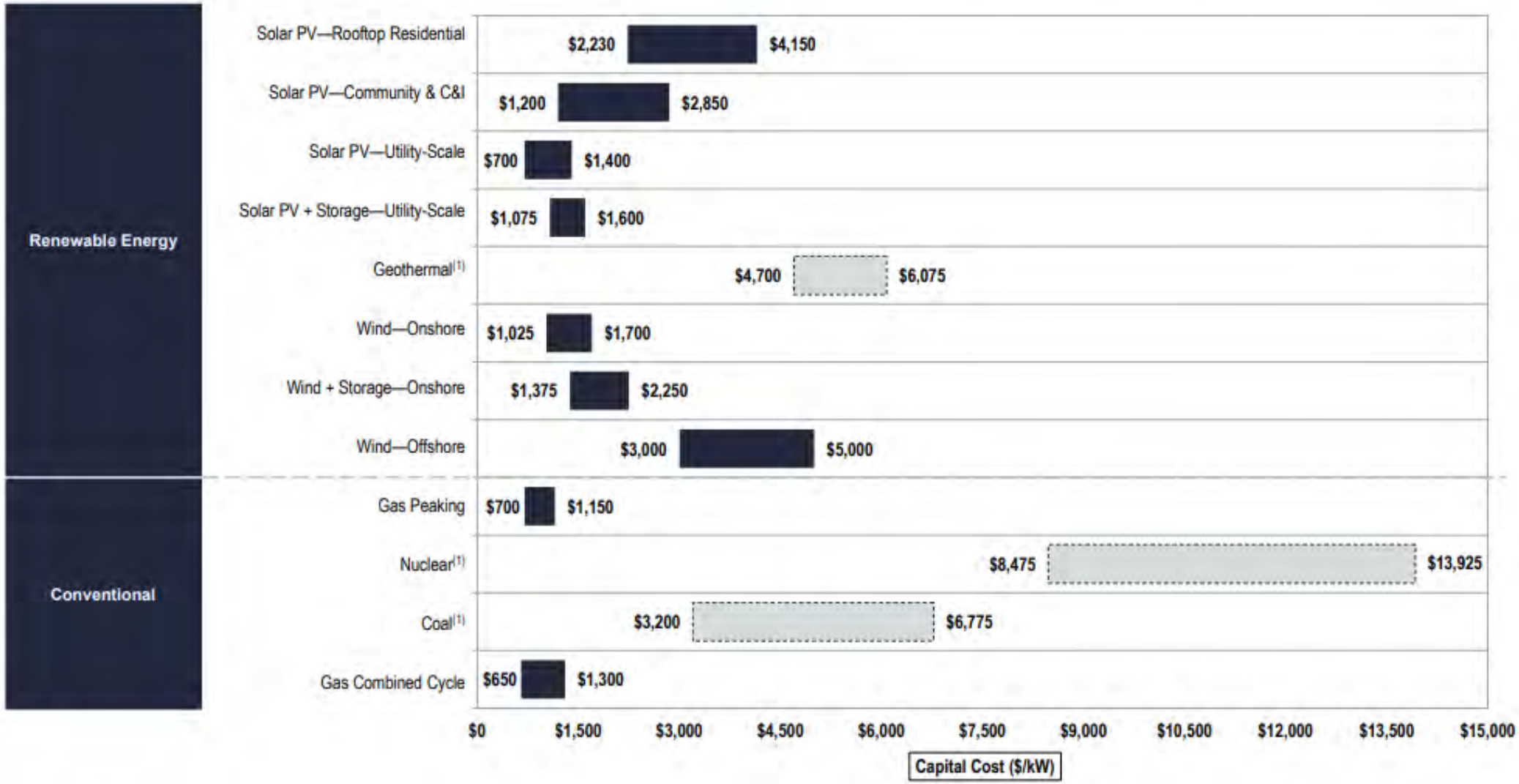
Generation Resource Procurement Example



- Adapted from Bent Flyvbjerg (Oxford) "How Big Things Get Done"
- 16,000 projects (20 years)
- Initial cost/budget to completion or abandonment
- Fat tail risk = high impact high risk
- Modularity = big project is really a series of smaller parts that can be mass produced
- This can be seen in comparing generation via the levelized cost of energy

Levelized Cost of Energy Comparison—Capital Cost Comparison

In some instances, the capital costs of renewable energy generation technologies have converged with those of certain conventional generation technologies, which coupled with improvements in operational efficiency for renewable energy technologies, have led to a convergence in LCOE between the respective technologies



Other factors to consider… intermittency, market saturation, diminishing returns…

- LCOE examines one all-in factor—energy—without context
- Analogous to looking at the levelized cost of shelter (“LCOS”) below

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$$$$

$$$$
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- In this example, the lowest levelized cost of shelter would be an umbrella

Regulator principles at work: Used and Useful Test

- Requires assets to be physically used and useful to current ratepayers before those ratepayers can be asked to pay the costs associated with them.

- Also provides a way to place definable limitations on costs charged to utility customers.

- The test keeps utility companies from investing in assets that do not provide a useful service and also to prevent any deliberate over-investing in an asset to purposefully inflate the rate base.

Used and Useful Principle

- Holds that utility customers should pay a return only on plant that actually is needed and used in providing utility service.

- Plant that ordinarily is excluded from the definition of used and useful plant includes:

  A. Duplicate and unnecessary plant

  B. Obsolete and inadequate plant

  C. Abandoned plant

  D. Plant acquired to meet future needs

  E. Plant still under construction

  F. Plant that is not operating due to managerial actions

Case Study: High Prairie Wind Farm

- Wind farm built on a endangered species mating ground
- Excessive “take” of species necessitated farm to be curtailed 30% of the year
- Long-term “cumulative” take of species may have impact on other farms

‘Bats will be killed’

But much of the scrutiny has also focused on the High Prairie wind farm. This spring, contractors hired by Ameren to study bird and bat deaths there **found multiple carcasses** of endangered Indiana bats and other protected species, including one bald eagle, near the project’s turbines, according to a report from Canada-based Stantec Consulting Services. Ameren, which was already slowing its turbines sunset to sunrise, on April 19 began shutting them down altogether at night.

- Gray, B. (2021) “An Ameren wind farm isn’t running at night to save bats. Should customers pay for that?” *St. Louis Post-Dispatch*. Oct. 11. https://www.stltoday.com/business/local/an-ameren-wind-farm-isn-t-running-at-night-to-save-bats-should-customers-pay/article_65026f6b-76b5-5de7-a392-e8ed4479b7db.html#tncms-source=login

Regulator principles at work: Cost Causation

- Fundamental principles of rate design.
- The alignment of cost allocation with cost causation promotes economically efficient production, consumption and investment decisions by sending clear price signals

TITLE 83: PUBLIC UTILITIES
CHAPTER I: ILLINOIS COMMERCE COMMISSION
SUBCHAPTER f: TELEPHONE UTILITIES
PART 791 COST OF SERVICE
SECTION 791.30 COST CAUSATION PRINCIPLE

Section 791.30 Cost Causation Principle

Costs shall be attributed to individual services or groups of services based on the following cost causation principle. Costs are recognized as being caused by a service or group of services if:

a) The costs are brought into existence as a direct result of providing the service or group of services; or

b) The costs are avoided if the service or group of services is not provided.

- Expressed as both “cost causer pays” and “beneficiary pays.”

- The basic idea is to draw a logical connection between the actions that cause costs to be incurred and the incentives provided by the allocation of costs.

- Does not need to be a precise dollar-for-dollar correspondence (in fact, the degree of correspondence can be wide);however, there should be positive benefits when costs increase.

- An important feature of this principle is to focus on incremental or marginal costs of an action as distinct from the average cost of a collection of decisions. The marginal cost, not average cost, is relevant to decisions and support of economic efficiency.

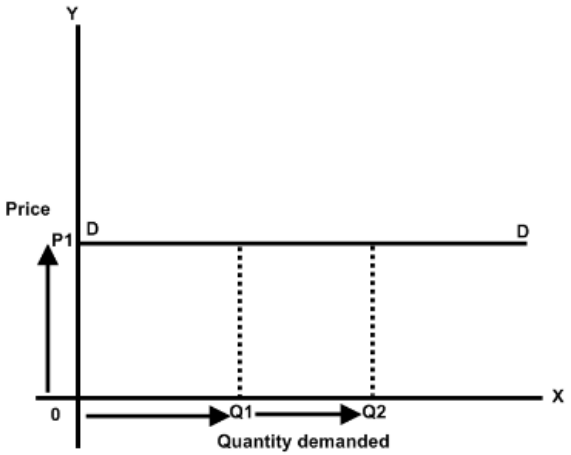
- This can be controversial – case study later on water consolidation

Pricing Objectives: Efficiency and Equity

Price Elasticity of Demand

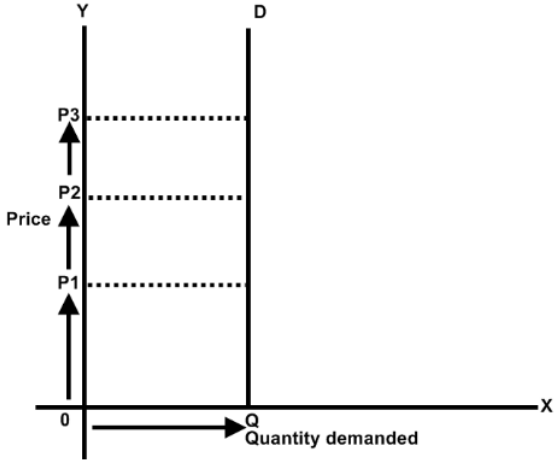
- Elasticity of demand = the percentage change in quantity demanded to the percentage change in price

Perfectly Elastic Demand



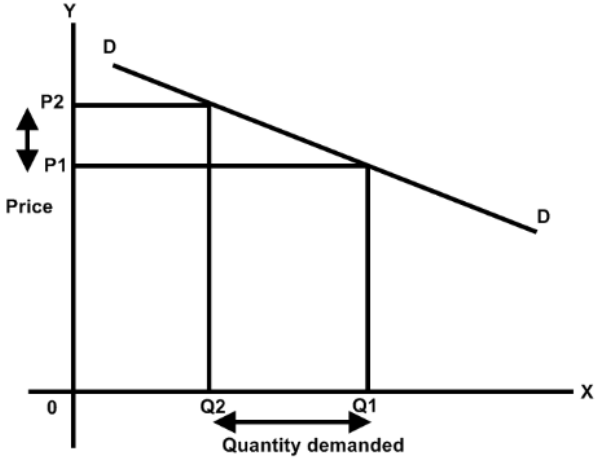
All or nothing

Perfectly Inelastic Demand



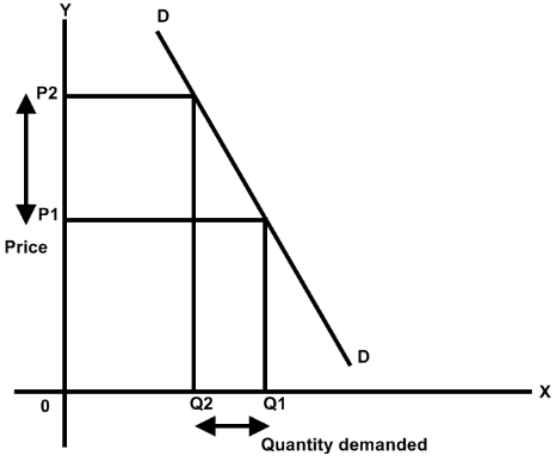
Medical emergency

Relatively Elastic Demand



Luxury items

Relatively Inelastic Demand



Utility service*

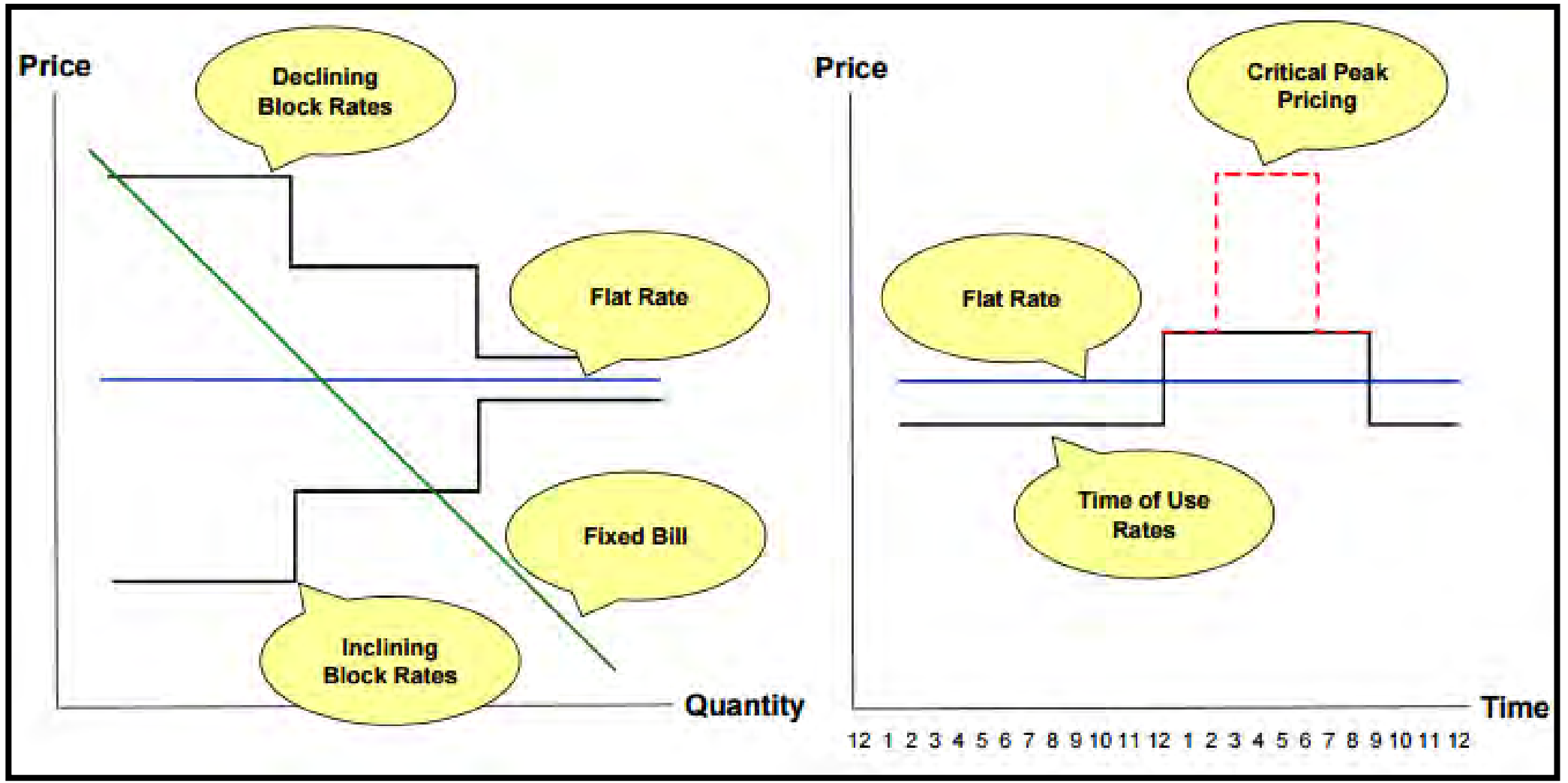
Price Elasticity can be affected by:

- **Substitutes**: If there are substitutes for the product, then demand for that product is likely to be elastic

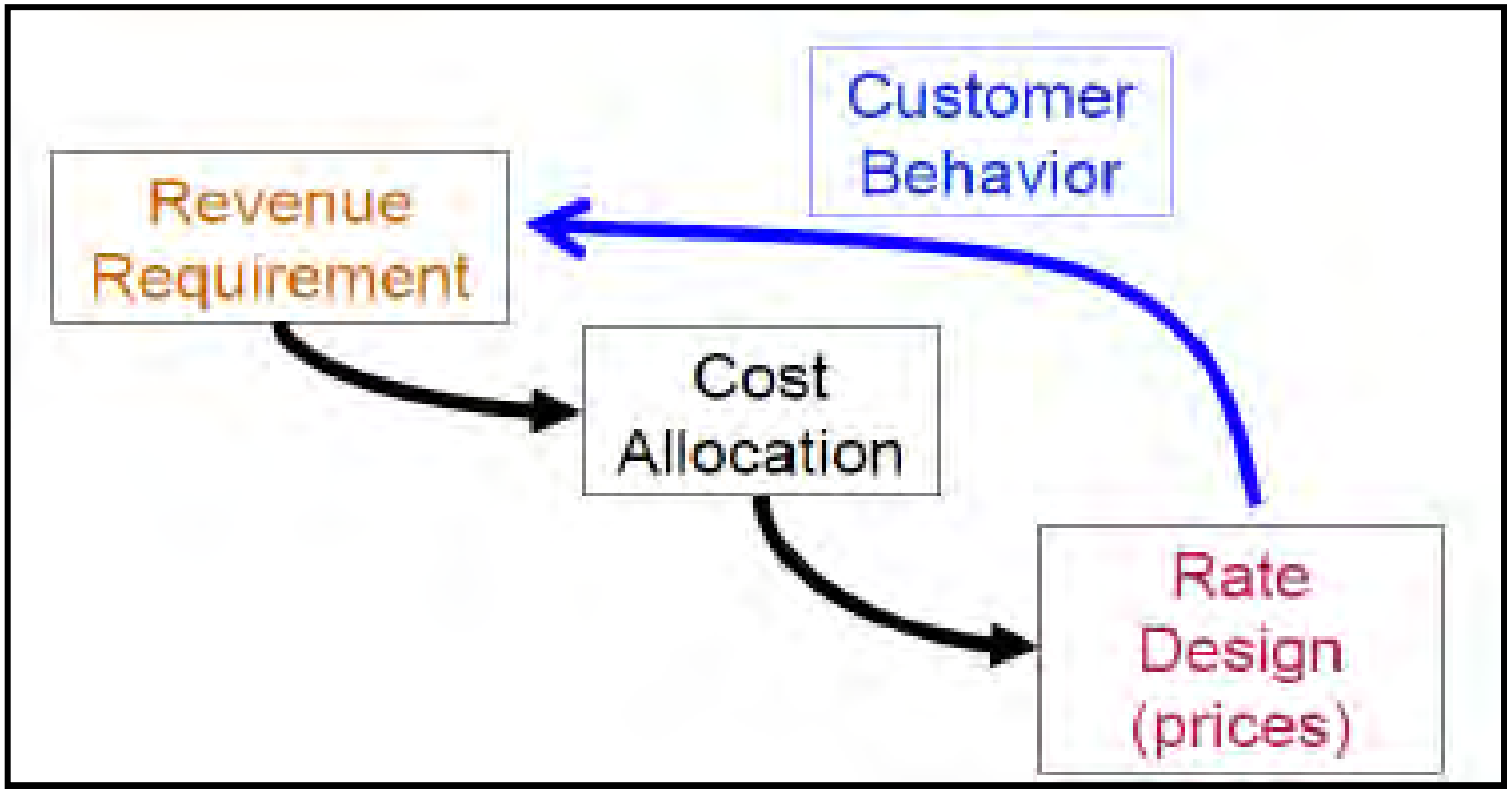
- **Importance**: Is the product essential? If yes, then it is likely to be inelastic.

- **Time**: Is the price change temporary or permanent? For example if gas goes up for a few weeks, people may switch to public transportation. If it is persistent then maybe people go electric

Pricing influences usage



The Feedback Loop (again)



Economic *Efficiency*

- Efficiency is concerned with the optimal production and distribution of scarce resources.

- Different types of efficiency
  - Productive – producing for the lowest cost.
  - Allocative – distributing resources according to consumer preference
  - Static – refinement of existing products, processes and capabilities
  - Dynamic – Adaptation of new products, processes and capabilities.
  - X-efficiency – how efficient within a given market
  - Efficiency of scale – taking advantage of economies of scale.
  - Social efficiency – taking into account external costs/benefits.

Impediments to economic efficiency from regulation (i.e., regulatory failure)

- Lack of information (asymmetric information)
  - Discovery and knowing what to ask
  - Resource allocation
  - Affiliate transactions
- Cost Shifting
  - Who bears the risk?
  - Subsidies between classes
  - Collective action problem
- Special Interests
  - Political or other interest groups
  - Regulatory capture

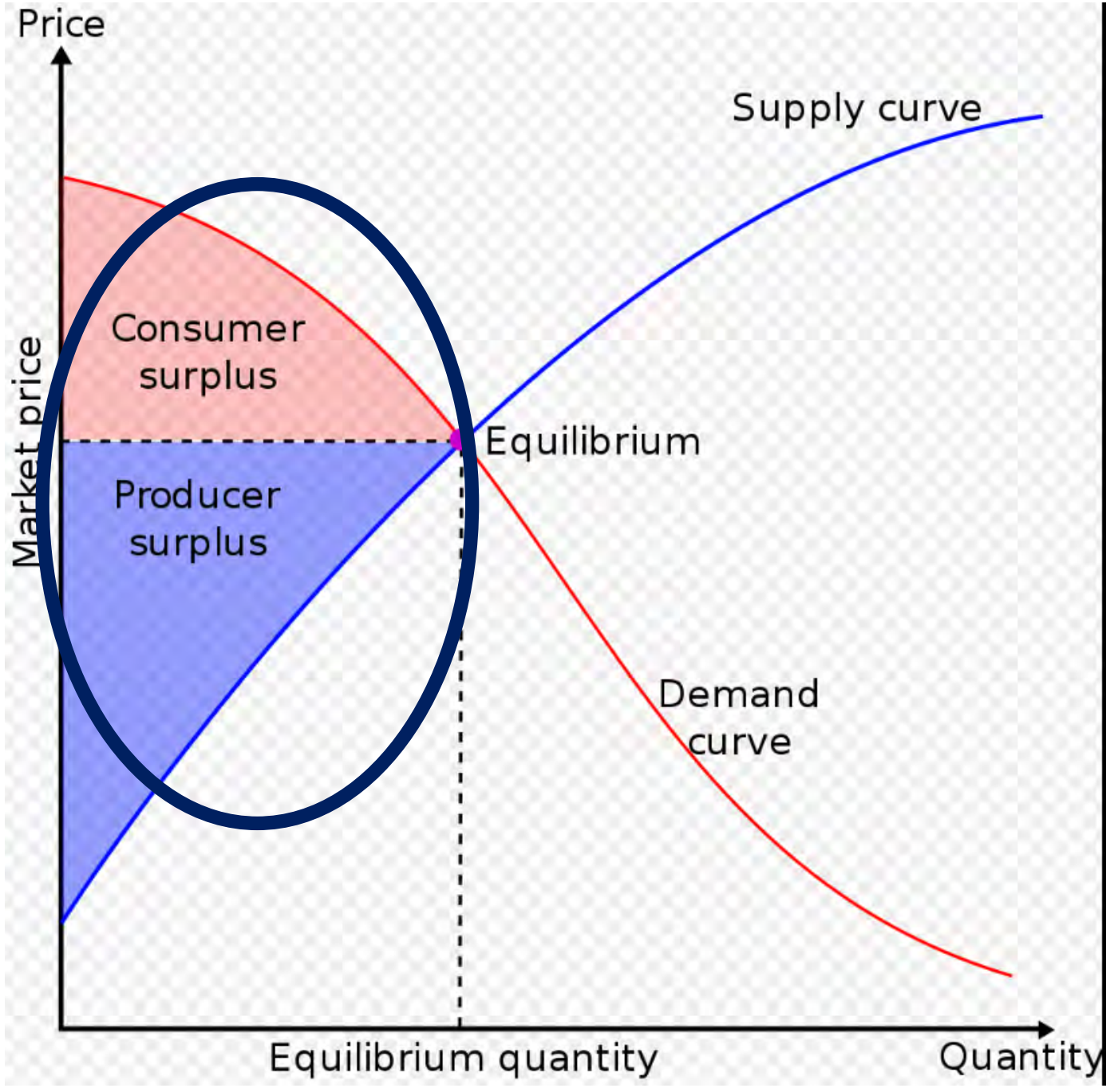
Economic Surplus

supply and demand curve

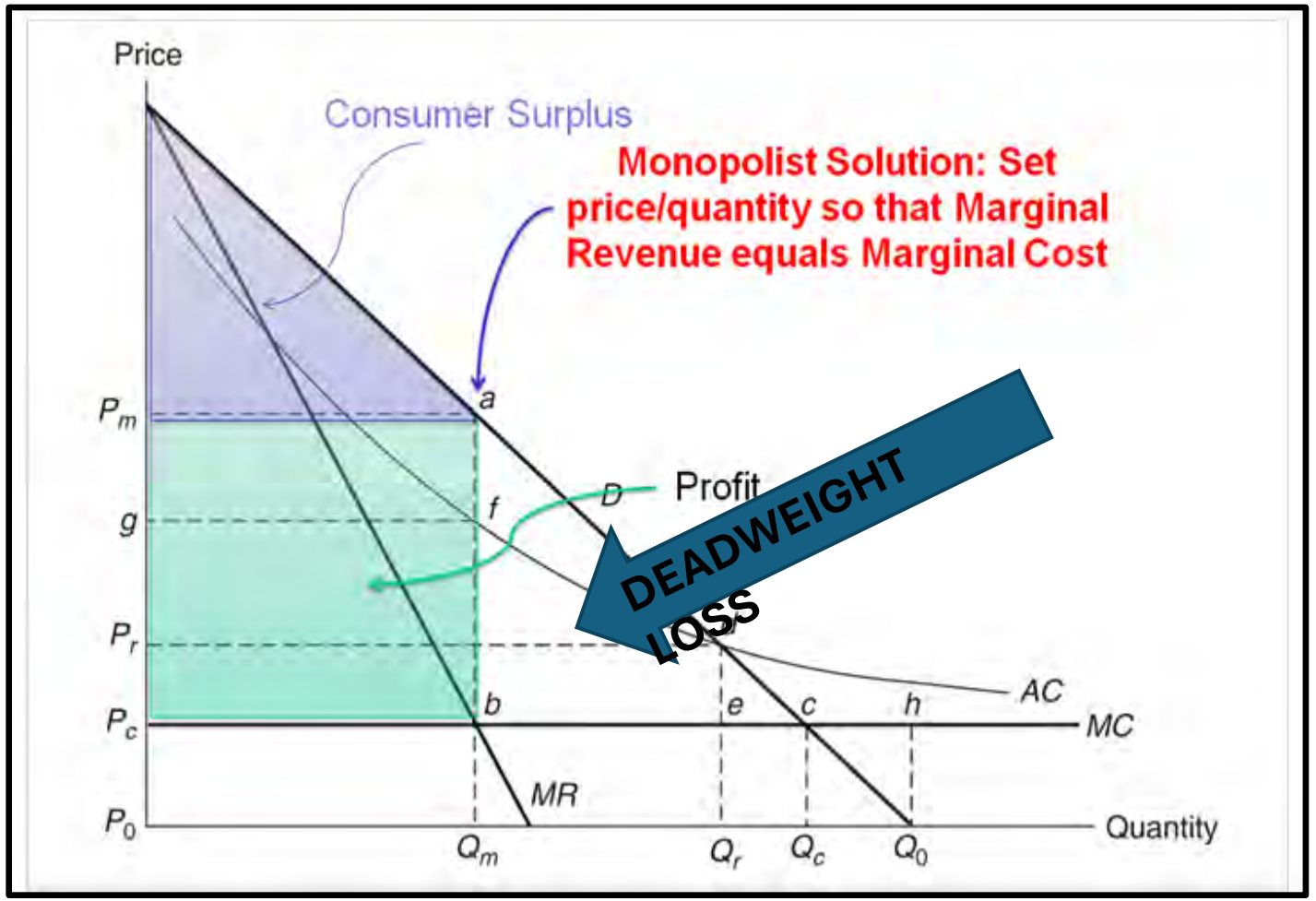
- Consumer Surplus
- $ savings for consumers (they get the product but would be willing to pay more

- Producer Surplus
- $ revenues for producers (get $ for selling at price that is higher than the least they would be willing to sell for)

- Welfare Criteria or Economic Surplus:
- Consumer + producer = total surplus

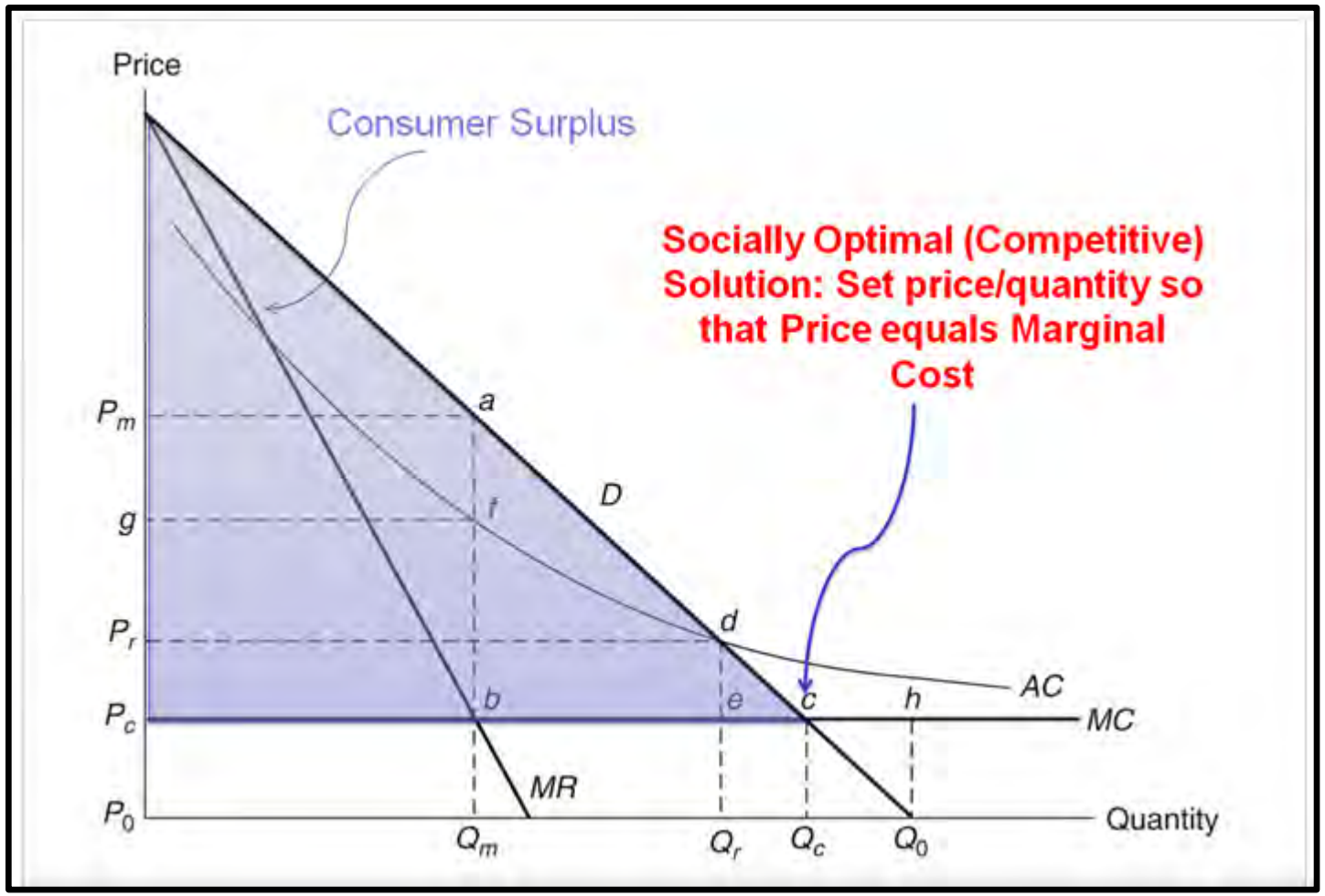


Consumer and Producer Welfare Under an Unregulated Electric Monopoly



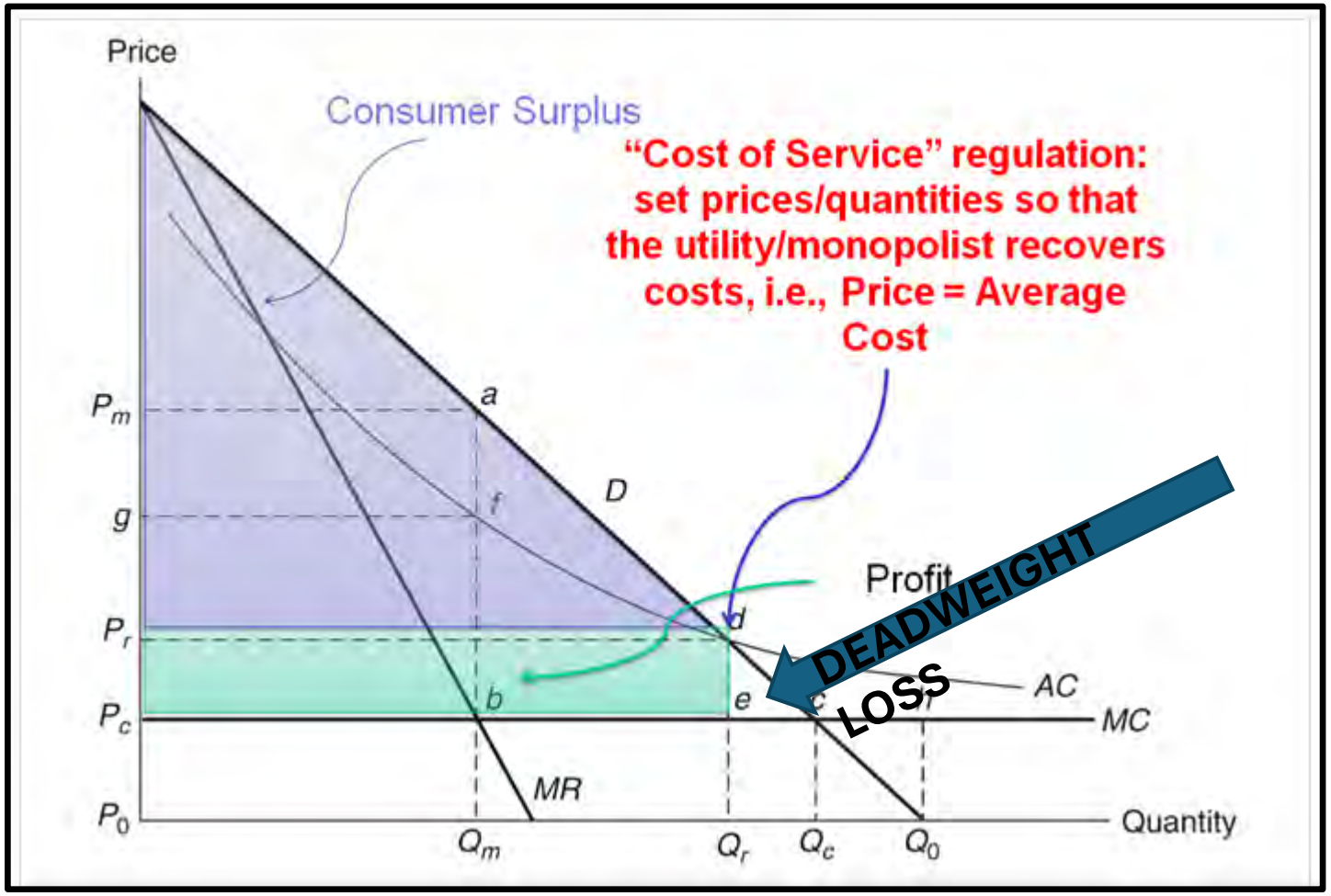
- **<u>Deadweight loss</u>**:
- A cost to society that occurs when a market is inefficient, or when supply and demand are out of balance.
- Loss of economic efficiency… or fewer goods/services at higher costs

Consumer and Producer Welfare Under Utility Regulation that Forces Prices to Equal Marginal Costs



- No deadweight loss!
- Great for consumers
- Great for the short run but bad in the long run due to lumpy fixed costs
- Will bankrupt the utility

Consumer and Producer Welfare Under Cost of Service Regulation, Where Prices Equal Average Costs



- Average costs = profits + enough to cover fixed and variable costs to provide service

The two–part tariff

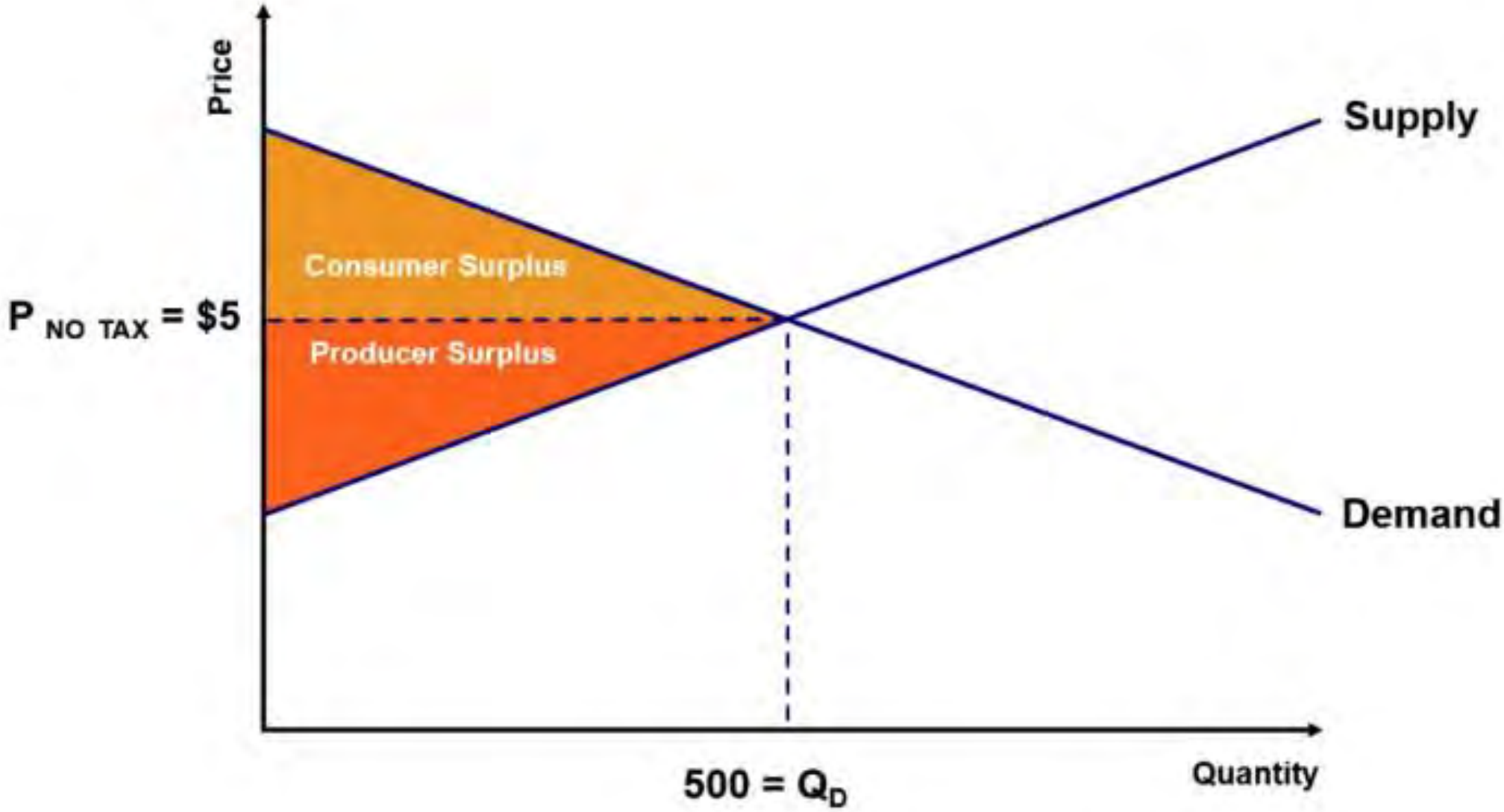
- Suppose the regulator forces our monopolist to sell every unit of output at 10 cents (i.e. P = MC), but also allows the utility to charge a fixed (flat) fee that all consumers must pay before buying this product at $15.
  - Lump sum fee; and
  - A per-unit charge

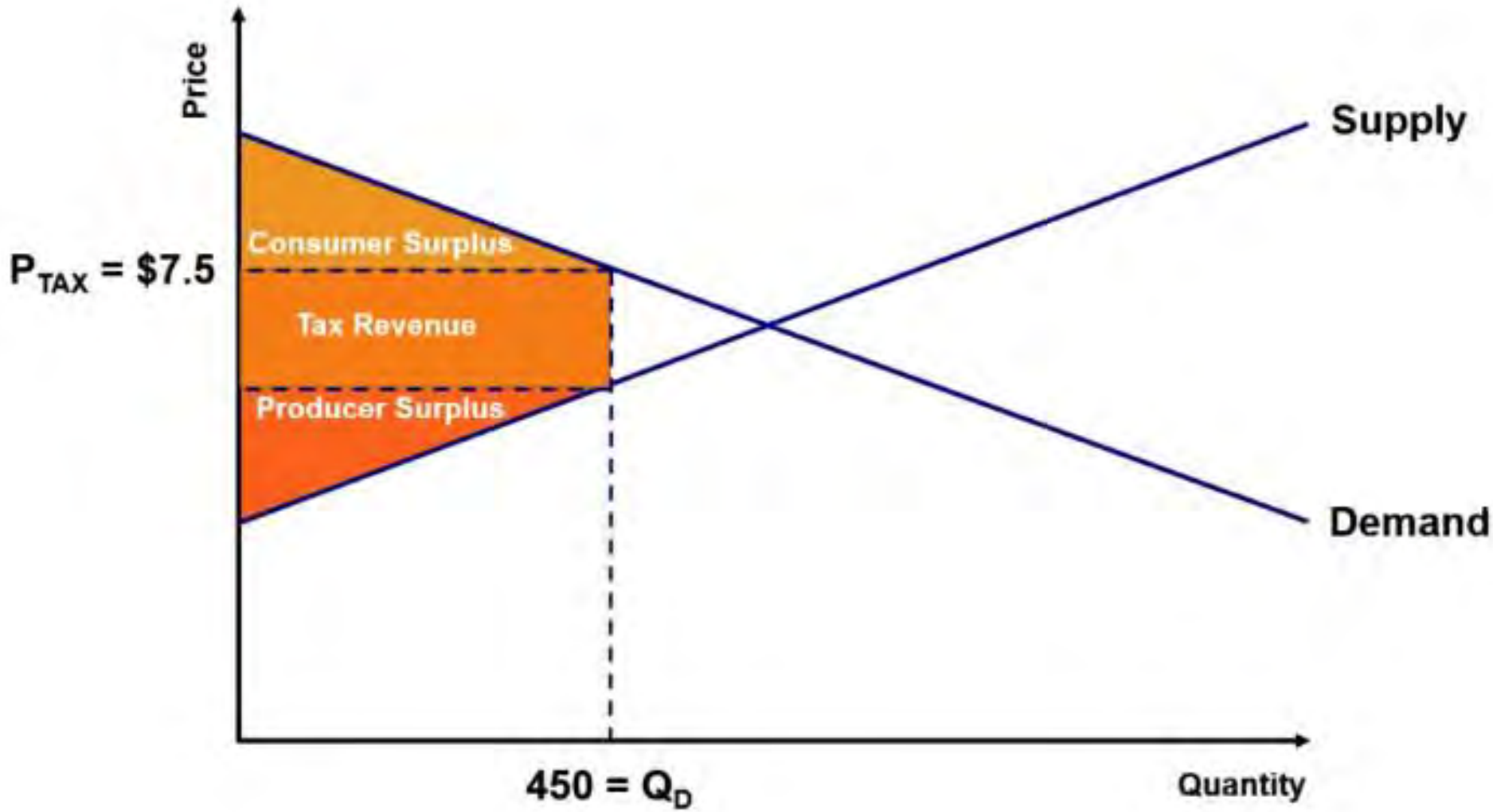
- In other words, the natural monopoly is allowed to charge something we could call an admittance fee—or what we call a “customer charge.”
- This fee establishes who is in the market.
- Those consumers who pay the fee are subsequently allowed to buy as much product as they want at $15 per unit (the MC price).

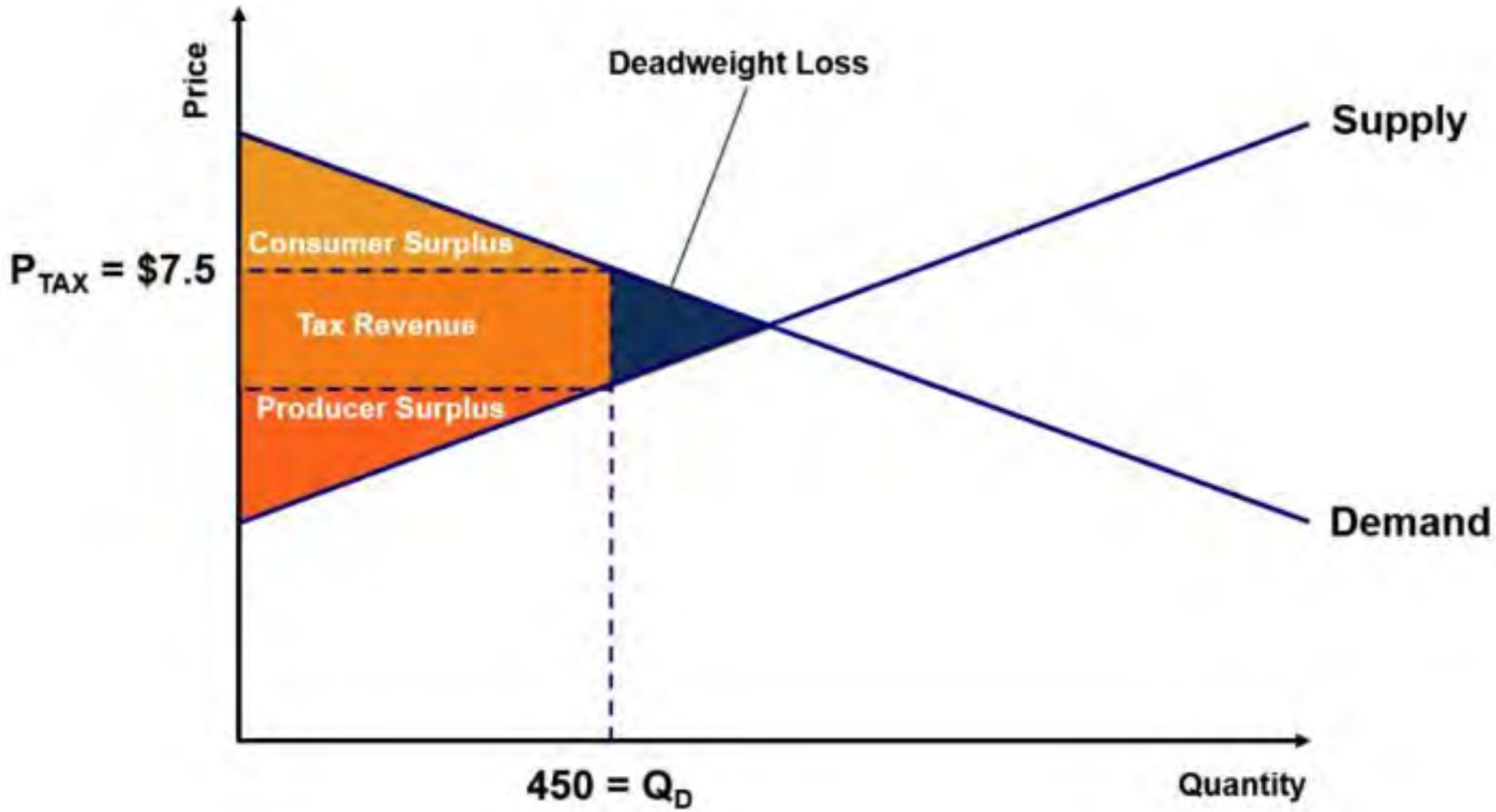
Deadweight tax loss illustration

- A has an opportunity cost of $80
- B is willing to pay up to $120 for A's service.
- A and B agree on $100 for transaction
- A's surplus = $20
- B's surplus = $20
- Total surplus of transaction = $40

- If government imposes a $50 tax on the $100 transaction
- B is priced out at $150 or $30 more than willing to pay.
- A no longer receives payment
- Both are made worse off to the tune of $40; and
- Government revenues decline
- That's deadweight loss – the loss of economic efficiency


Price
Supply
Consumer Surplus
P NO TAX = $5
Producer Surplus
Demand
500 = QD
Quantity

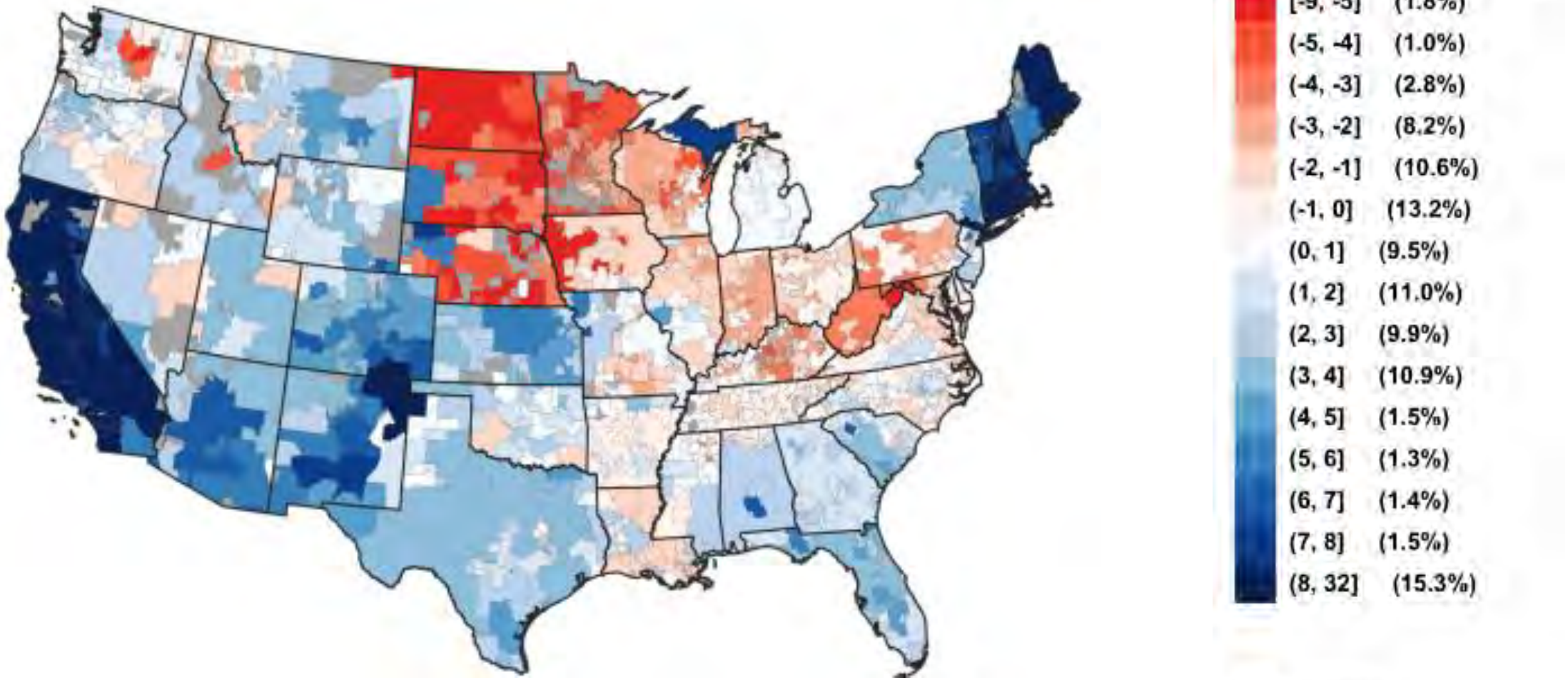

Price
Supply
Consumer Surplus
P_{TAX} = $7.5
Tax Revenue
Producer Surplus
Demand
450 = Q_D
Quantity


Price
Deadweight Loss
Supply
Consumer Surplus
P_{TAX} = $7.5
Tax Revenue
Producer Surplus
Demand
450 = Q_D
Quantity

Theoretical: Social Marginal Price

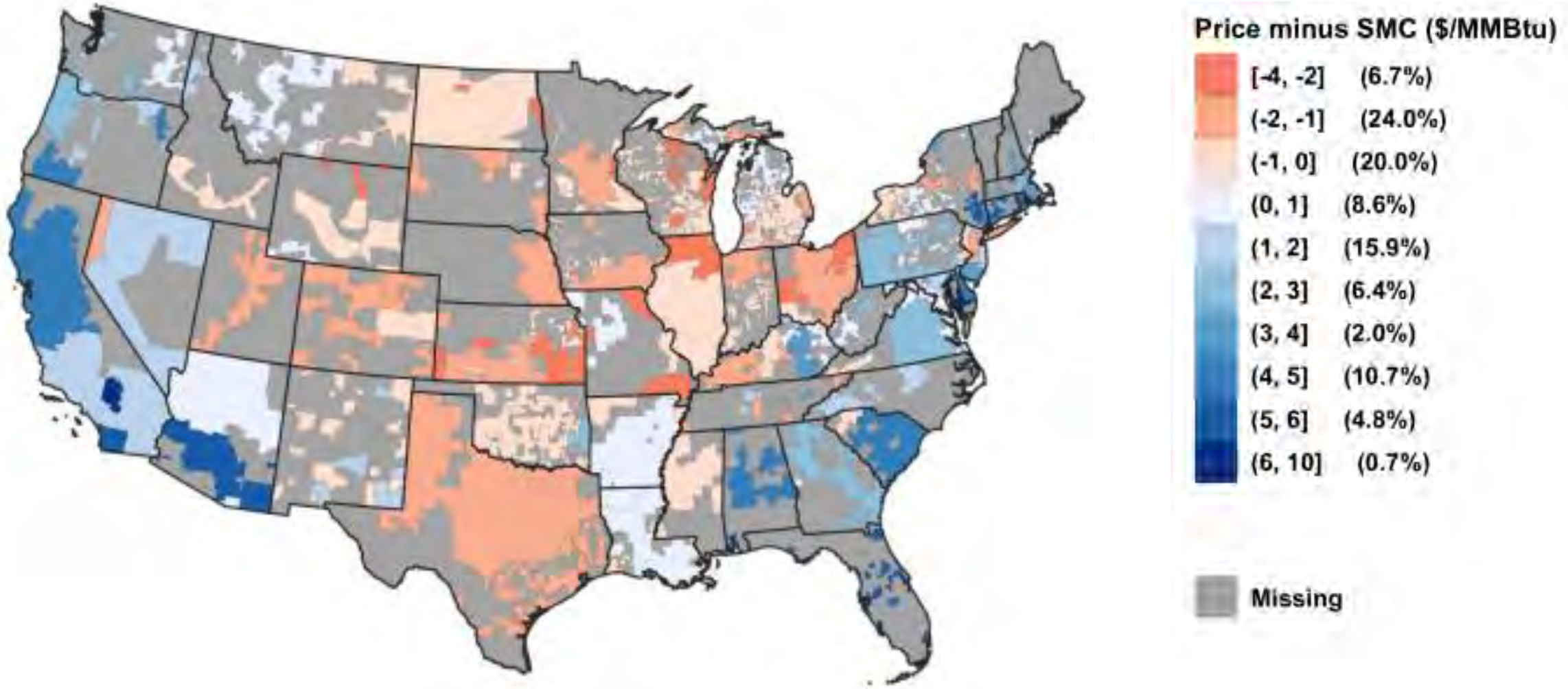
- How far are electricity prices from “the ideal” social marginal cost (SMC)?
- **Marginal cost** is the additional cost of producing a little more of a good, or the savings from producing a little less.
- The “**social**” part means that it counts not only the private marginal costs incurred by the seller, but also the pollution damages and other spillovers onto people who are not part of the transaction.
- Argument is that all energy prices are mispriced due in part to the unpriced pollution they emit.

Price minus social marginal costs across electricity

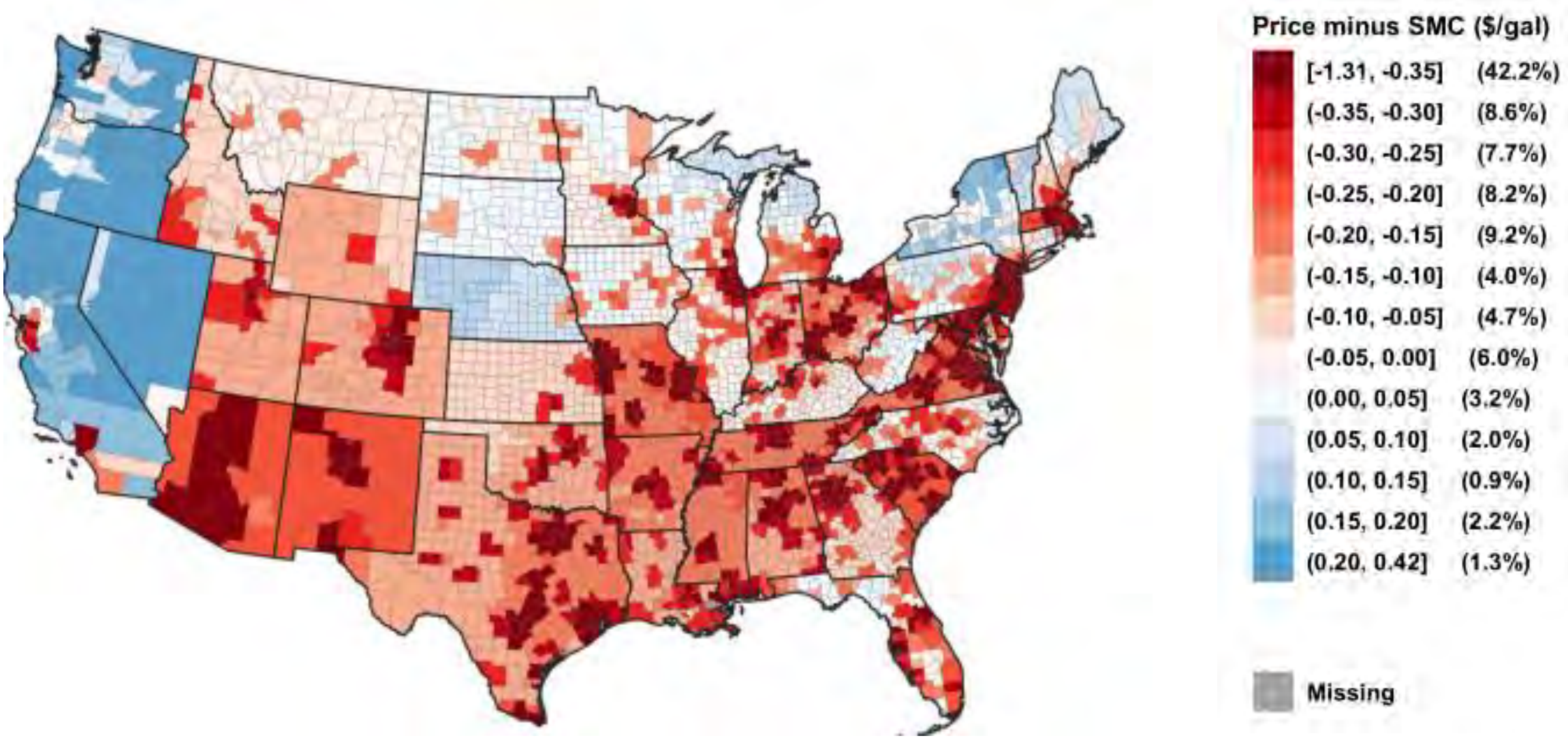


- Borenstein, S. & Bushnell J. Headwinds and Tailwinds: Implications of Inefficient Retail Energy Pricing for Energy Substitution (2021) *Energy Institute* WP 319R.
- https://haas.berkeley.edu/wp-content/uploads/WP319.pdf

Price minus social marginal costs across natural gas

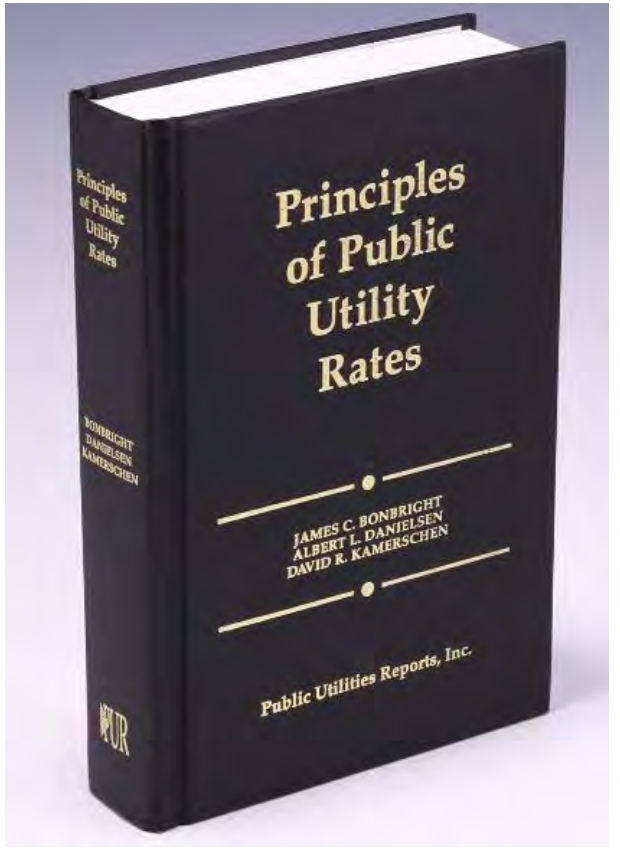


Price minus social marginal costs across gasoline



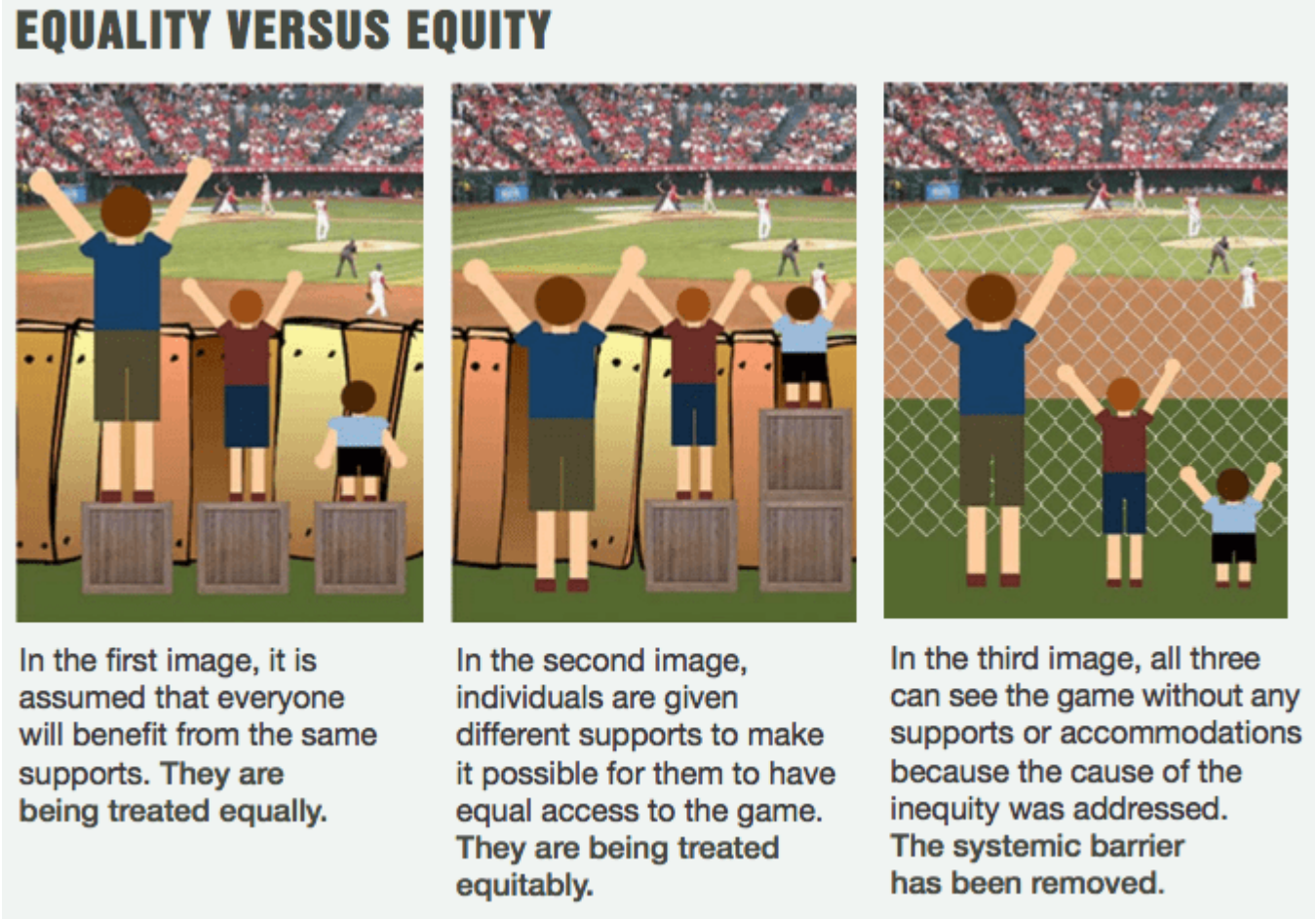
Bonbright Principles

10 Bonbright Principles	5 Core Principles
1. Effectiveness in yielding total revenue requirements under the fair-return standard without any socially undesirable expansion of the rate base or socially undesirable level of product quality and safety.	Revenue adequacy and stability
2. Revenue stability and predictability, with a minimum of unexpected changes that are seriously adverse to utility companies.	
3. Stability and predictability of the rates themselves, with a minimum of unexpected changes that are seriously adverse to utility customers and that are intended to provide historical continuity.	Bill stability
4. Static efficiency, i.e., discouraging wasteful use of electricity in the aggregate as well as by time of use.	Economic efficiency
5. Reflect all present and future private and social costs in the provision of electricity (i.e., the internalization of all externalities).	
6. Fairness in the allocation of costs among customers so that equals are treated equally.	Equity
7. Avoidance of undue discrimination in rate relationships so as to be, if possible, compensatory (free of subsidies).	
8. Dynamic efficiency in promoting innovation and responding to changing demand-supply patterns.	
9. Simplicity, certainty, convenience of payment, economy in collection, understandability, public acceptability, and feasibility of application.	Customer satisfaction
10. Freedom from controversies as to proper interpretation.	



Economic Equity

- Equity, or economic equality, is **the concept or idea of fairness in economics**.
- Typically invoked on grounds of fairness
- Equality
  - Level playing field
- Equity
  - Looks at the distribution of capital, goods and access to services throughout an economy



Energy Burden

Energy Burden = Household Energy Costs / Household Income

E.g. $1,500 Annual Energy Cost / $50,000 Annual Income = 3% Energy Burden

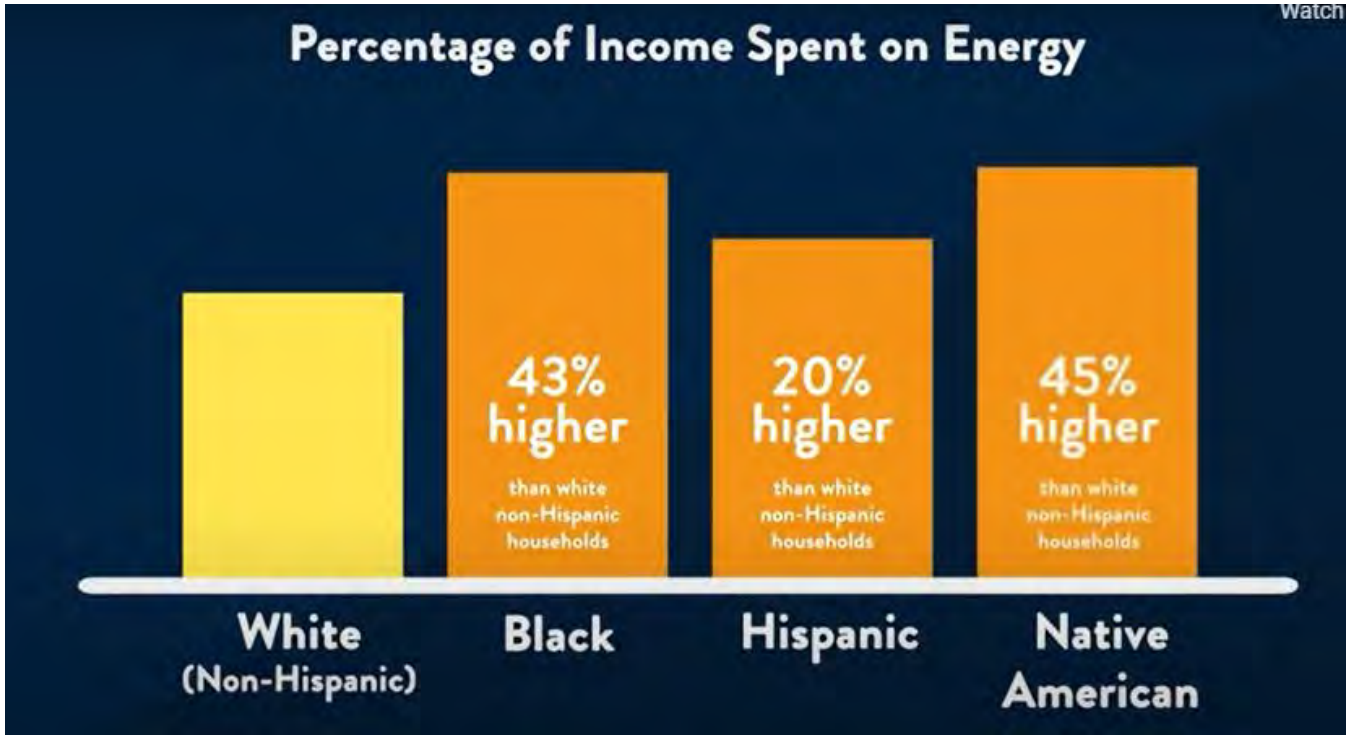


Table 8: S&P Global Market Intelligence 2018 four largest average annual electric residential bills

US Rank	Utility	Largest Average Residential Annual Bill
1	Maui Electric	$2,141
2	Hawaii Electric Light	$2,096
3	Nantucket Electric Co.	$2,077
4	**Empire District Electric**	**$1,936**

- 6% = high energy burden

Table 9: Select 2018 American Community Survey Economic Data of relevant service territory[19]

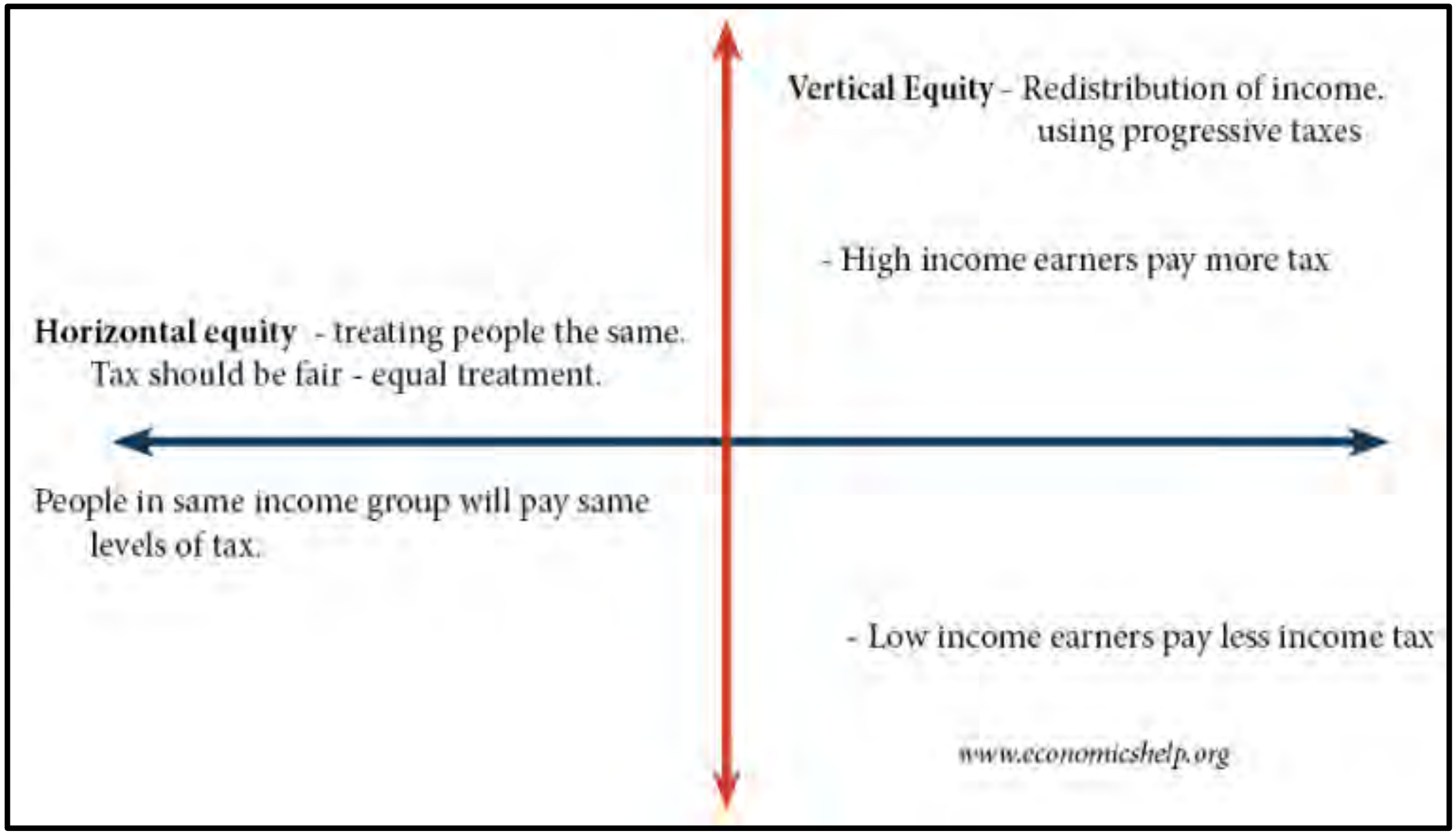
Area	Mean Household Income	Median Household Income	Below Poverty Rate % Below $24,600 family of four Missouri or $28,870 Hawaii	Child Poverty Rate % Under 18
Islands				
Maui (Maui Electric)	$99.3	$77.1	9.7	11.7%
Honolulu (Hawaii Electric Light)	$105.0	$82.9	8.7%	10.7%
Nantucket[20] (Nantucket Electric Co.)	$137.8	$105.2	X	X
Empire MO Counties				
Barry	$56.6	$41.5	21.0%	32.6%
Barton	$62.4	$41.6	21.6%	29.5%
Cedar	$53.4	$39.4	18.5%	24.4%
Christian	$70.8	$57.0	10.2%	13.1%
Dade	$51.7	$40.0	22.5%	36.3%
Dallas	$58.0	$41.6	15.0%	18.3%
Greene	$61.8	$44.8	17.9%	20.5%
Hickory	$44.6	$36.2	17.4%	20.2%
Jasper	$61.4	$47.0	17.4%	25.2%
Lawrence	$57.1	$43.4	16.9%	28.4%
McDonald	$54.7	$42.0	19.5%	28.5%
Newton	$69.0	$49.0	13.9%	18.2%
Polk	$59.5	$44.9	14.5%	16.3%
St. Clair	$51.6	$38.5	17.6%	25.4%
Stone	$62.8	$46.4	12.6%	18.9%
Taney	$53.1	$41.5	17.2%	24.6%
Other				
US	$84.9	$60.3	14.1%	19.5%
Missouri	$73.1	$53.6	14.2%	19.5%

Efficiency Vs Equity

- **Efficiency** is concerned with the optimal production and allocation of resources given existing factors of production. For example, producing at the lowest cost.
- **Equity** is concerned with how resources are distributed throughout society (not to be confused with the capital of a firm).
- **Vertical equity** is concerned with how equitably resources are distributed and may imply higher tax rates for high-income earners.
- **Horizontal equity** is treating everyone in the same situation the same. e.g. everyone earning $X should pay the same tax rates.

- *"The inherent vice of capitalism is the unequal sharing of the blessings. The inherent blessing of socialism is the equal sharing of misery."*

Winston Churchill


Vertical Equity – Redistribution of income.
using progressive taxes
- High income earners pay more tax
Horizontal equity - treating people the same.
Tax should be fair - equal treatment.
People in same income group will pay same
levels of tax.
- Low income earners pay less income tax
www.economicshelp.org

Question:
Are Clean Energy Tax Credits Equitable?

Q. What improvements qualify for the residential energy property credit for homeowners?

A. In 2018 and 2019, an individual may claim a credit for (1) 10 percent of the cost of qualified energy efficiency improvements and (2) the amount of the residential energy property expenditures paid or incurred by the taxpayer during the taxable year (subject to the overall credit limit of $500).

Qualified energy efficiency improvements include the following **qualifying** products:

- Energy-efficient exterior windows, doors and skylights
- Roofs (metal and asphalt) and roof products
- Insulation

Residential energy property expenditures include the following qualifying products:

- Energy-efficient heating and air conditioning systems
- Water heaters (natural gas, propane or oil)
- Biomass stoves

https://www.irs.gov/newsroom/energy-incentives-for-individuals-residential-property-updated-questions-and-answers

Table 1: Annual Expenditures on U.S. Clean Energy Tax Credits, in Millions

Year	Windows & Other Energy-Efficiency Investments (NEPC)	Solar Panels and Other Residential Renewables (REEPC)	Hybrids and Other Alternative Fuel Vehicles (AMVC)	Electric and Plug-In Hybrid Vehicles (PEDVC)
2005	$0	$0	$0	$0
2006	$957	$43	$50	$0
2007	$938	$69	$185	$0
2008	$0	$217	$49	$0
2009	$5177	$645	$137	$129
2010	$5420	$754	$93	$1
2011	$755	$921	$14	$76
2012	$449	$818	$20	$139
Total	$13696	$3467	$549	$346

Note: This table was constructed by the authors using U.S. Department of the Treasury, Internal Revenue Service, "Statistics of Income, Individual Tax Returns," 2005–2012 and U.S. Department of the Treasury, Internal Revenue Service, "Individual Income Tax Returns Line Item Estimates," 2005–2012. See Appendix A for details. Tax credits across all four categories totaled $18.1 billion between 2005 and 2012.

$18 Billion

Table 2: Distributional Effects of Selected Tax Credits

	Percent of Credit Received by Income Category (in thousands)						Concentration Index
	$0–$10	$10–$20	$20–$40	$40–$75	$75–$200	$200+	
Panel A. Clean Energy Tax Credits							
Residential Energy Credits	0%	1%	10%	28%	48%	14%	0.606
Alternative Motor Vehicle Credit	0%	1%	9%	32%	47%	11%	0.584
Plug-in Electric Drive Vehicle Credit	0%	0%	1%	10%	54%	35%	0.801
Panel B. Other Major Tax Credits							
Earned Income Tax Credit	18%	49%	32%	1%	0%	0%	–0.415
Making Work Pay Credit	7%	14%	25%	28%	26%	0%	0.163
Child Tax Credit	2%	13%	31%	31%	23%	0%	0.185
First-time Home Buyer Credit	7%	6%	23%	40%	24%	1%	0.222
Foreign Tax Credit	0%	0%	1%	2%	9%	88%	0.954

Note: This table was constructed by the authors using U.S. Department of the Treasury, Internal Revenue Service, "Statistics of Income, Individual Tax Returns," 2005–2012. The first five income categories are approximate quintiles (18%, 17%, 24%, 21%, 18%), and 3% of tax returns fall in the last category. Residential energy credits includes both the NEPC and the REEPC. The Earned Income Tax Credit, Making Work Pay Credit, Child Tax Credit, and the First-Time Home Buyer Credit are all refundable, while the Foreign Tax Credit is not. See Appendix A for details.

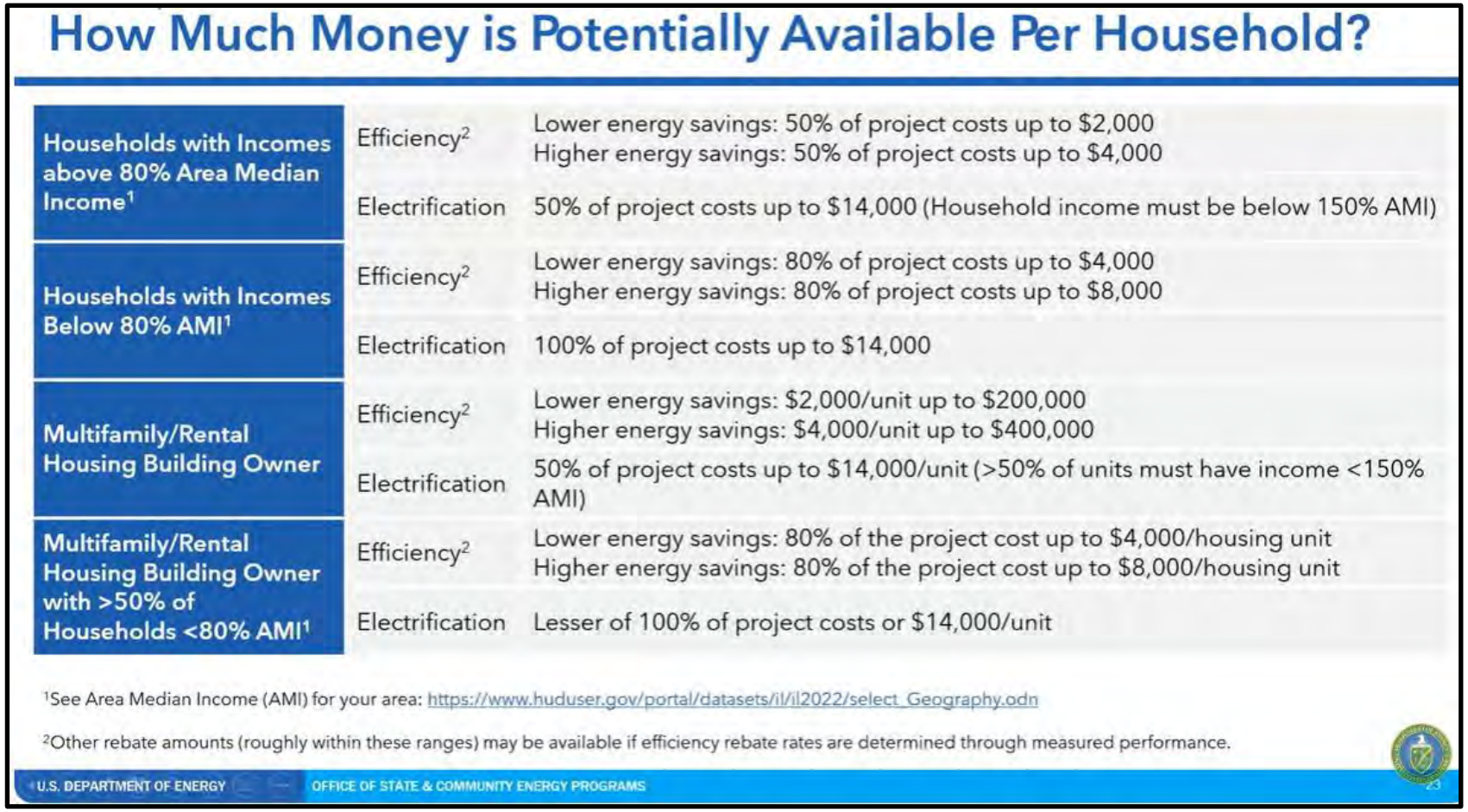
Are Clean Energy Tax Credits Equitable?

- Not on distributional grounds.
- Why?
- In 2012, for example, more than one-third of U.S. tax returns had zero tax liability.
- Clean Energy Tax Credits are non-refundable. You can use these credits to offset your tax bill, but you cannot go negative and receive a net payment from the IRS like you can with the Earned Income Tax Credit and many other tax credits.
- Also, renters… over 40 million American households are renters, and thus cannot take advantage of any of the credits aimed at weatherization, energy-efficiency, or solar PV.

Borenstein, Severin and Davis, Lucas "The Distributional Effects of U.S. Clean Energy Tax Credits" (July 2015) (Published in NBER Tax Policy and the Economy, University of Chicago Press, 30(1): 191-234, 2016) | WP-262 https://haas.berkeley.edu/wp-content/uploads/WP262.pdf

Inflation Reduction Act

- Attempts to rectify that mistake by addressing both tax breaks and income-qualified rebates



How Much Money is Potentially Available Per Household?

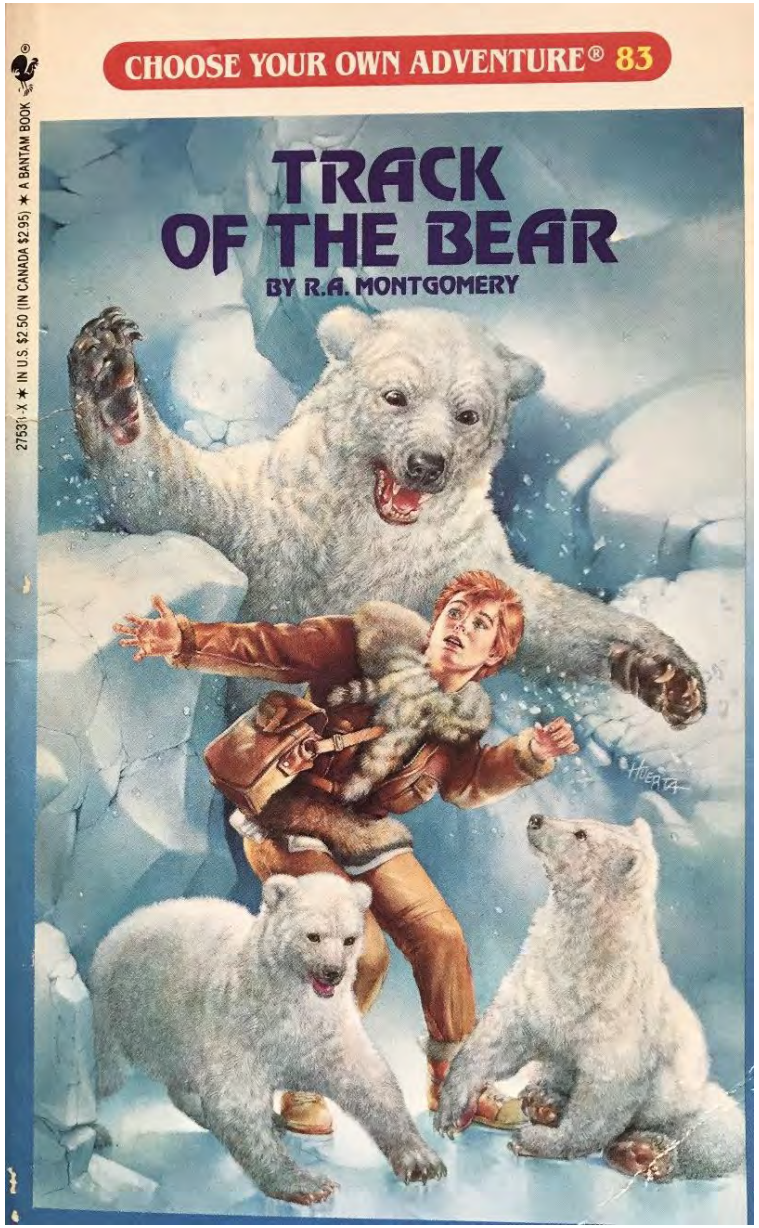
Households with Incomes above 80% Area Median Income[1]	Efficiency[2]	Lower energy savings: 50% of project costs up to $2,000 Higher energy savings: 50% of project costs up to $4,000
	Electrification	50% of project costs up to $14,000 (Household income must be below 150% AMI)
Households with Incomes Below 80% AMI[1]	Efficiency[2]	Lower energy savings: 80% of project costs up to $4,000 Higher energy savings: 80% of project costs up to $8,000
	Electrification	100% of project costs up to $14,000
Multifamily/Rental Housing Building Owner	Efficiency[2]	Lower energy savings: $2,000/unit up to $200,000 Higher energy savings: $4,000/unit up to $400,000
	Electrification	50% of project costs up to $14,000/unit (>50% of units must have income <150% AMI)
Multifamily/Rental Housing Building Owner with >50% of Households <80% AMI[1]	Efficiency[2]	Lower energy savings: 80% of the project cost up to $4,000/housing unit Higher energy savings: 80% of the project cost up to $8,000/housing unit
	Electrification	Lesser of 100% of project costs or $14,000/unit

[1]See Area Median Income (AMI) for your area: https://www.huduser.gov/portal/datasets/il/il2022/select_Geography.odn

[2]Other rebate amounts (roughly within these ranges) may be available if efficiency rebate rates are determined through measured performance.

Opportunity Costs and Externalities

Opportunity Costs



- Imagine you are setting out on a dangerous expedition through the Artic on a limited budget.
- The grizzled old prospector at the general store shakes his head sadly: you can't afford everything you need; you'll just have to purchase the bare essentials and hope you get lucky.
- But what is essential?
    - Parka or sleeping bag
    - Extra rations or a rifle?
    - Book on flowers? Authentic scarf? Camera?
- Buying one things costs money that could be used to buy others.
- Because resources are scarce, choices must be made in how to allocate them between society's competing needs and wants.
- Often equate this with money but also time.
    - The opportunity cost is the opportunity lost.
    - Nothing is free if there is an opportunity cost.

- **Opportunity Cost:** The highest-valued, next-best alternative that we sacrifice in order to satisfy another want.

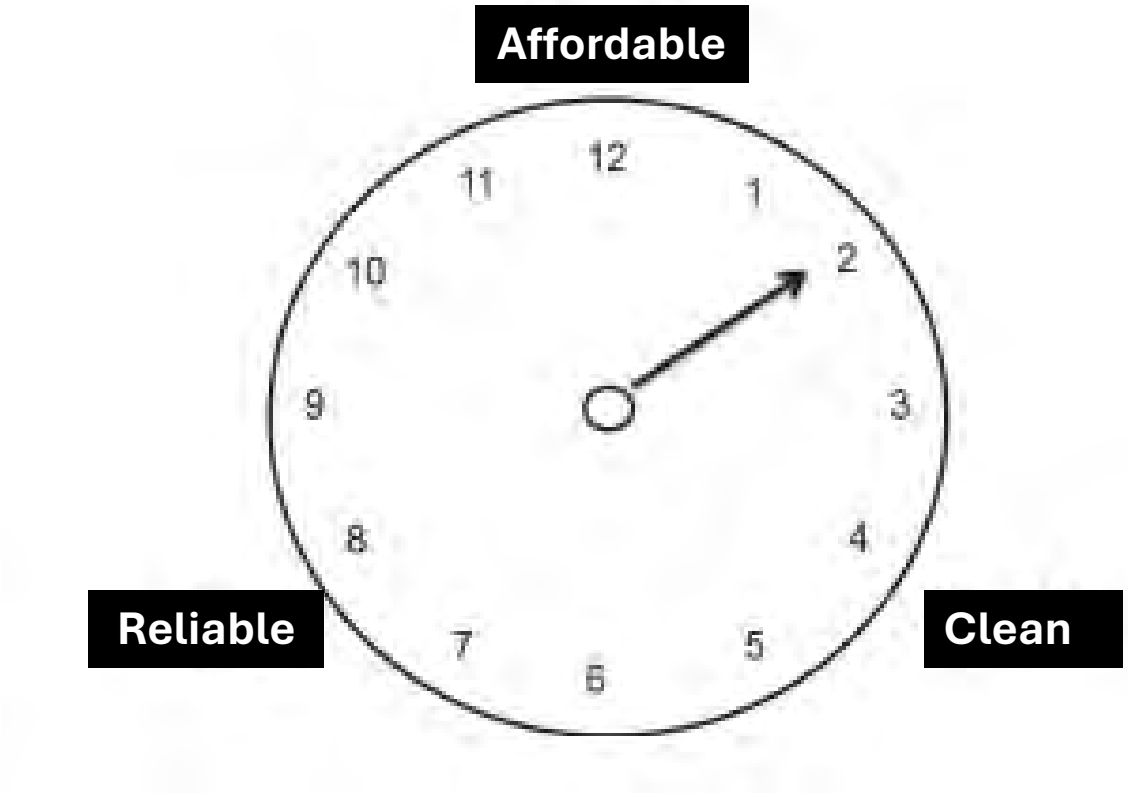
Closely related to

- **Scarcity**: a situation that results from the fact that we don't have the ability to satisfy all of our wants.
- Human wants and needs are infinite, but the resources needed to meet those wants and needs are limited and scarce.

Consider the conflicting goals attempted with providing electric service

- We can solve just about any problem, but we can't solve all problems.

- Or, the Everything Bagel Problem
- See also initial challenges with the IRA:
  - Clean energy
  - Union jobs
  - Equity distribution
  - Made in the USA
  - Reliability
  - Maintain conservation (natural) and security (cyber and natural)

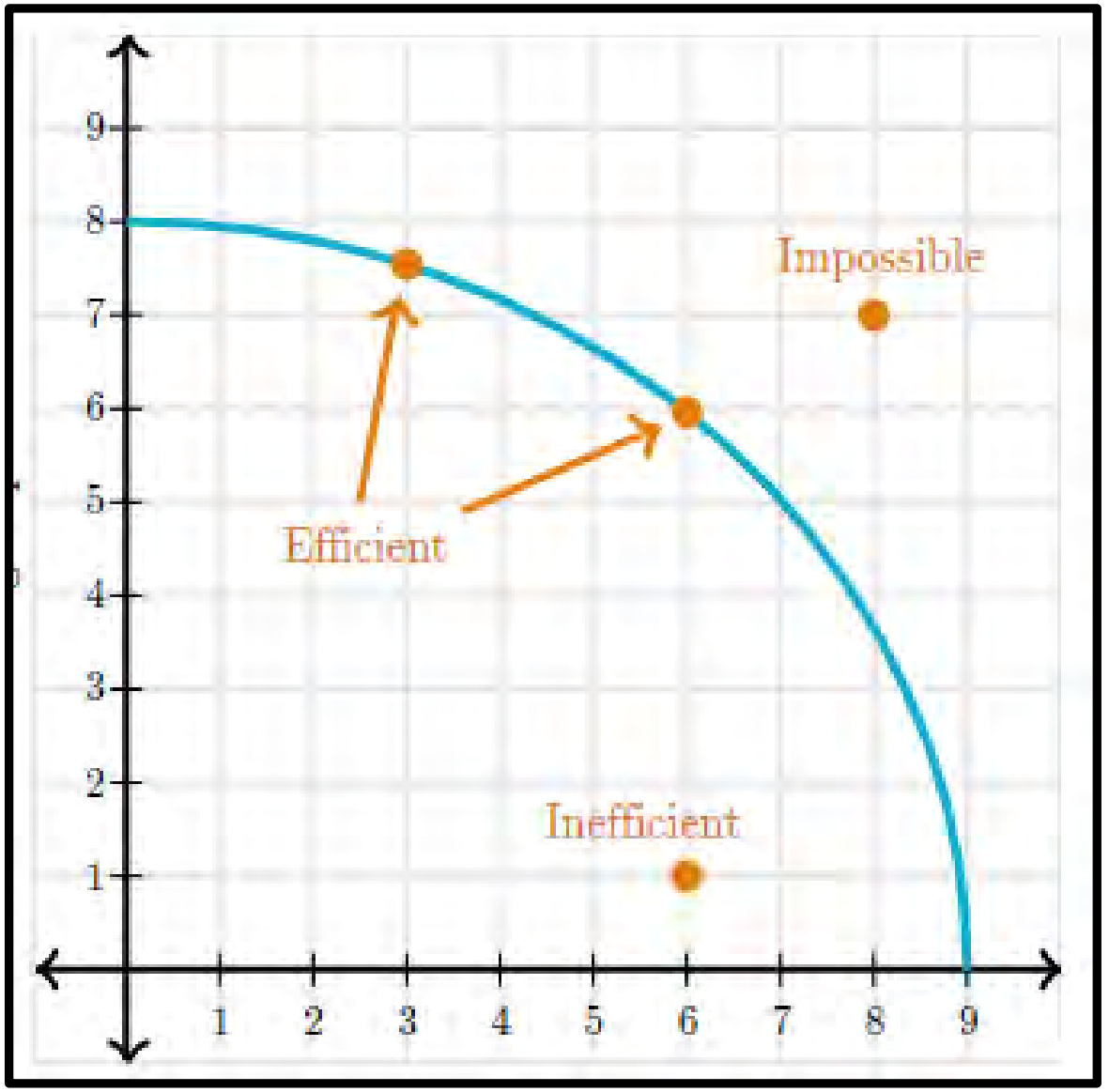


Adapted from Karl Wieck's clock metaphor on the impossibility of social behavior research to be simultaneously general, accurate and simple.

Production Possibility Curve

- How does this play out in public utility regulation?
- Rate Case
- Workshops
- Rulemaking
- Appeals

- All of these take up time and finite resources



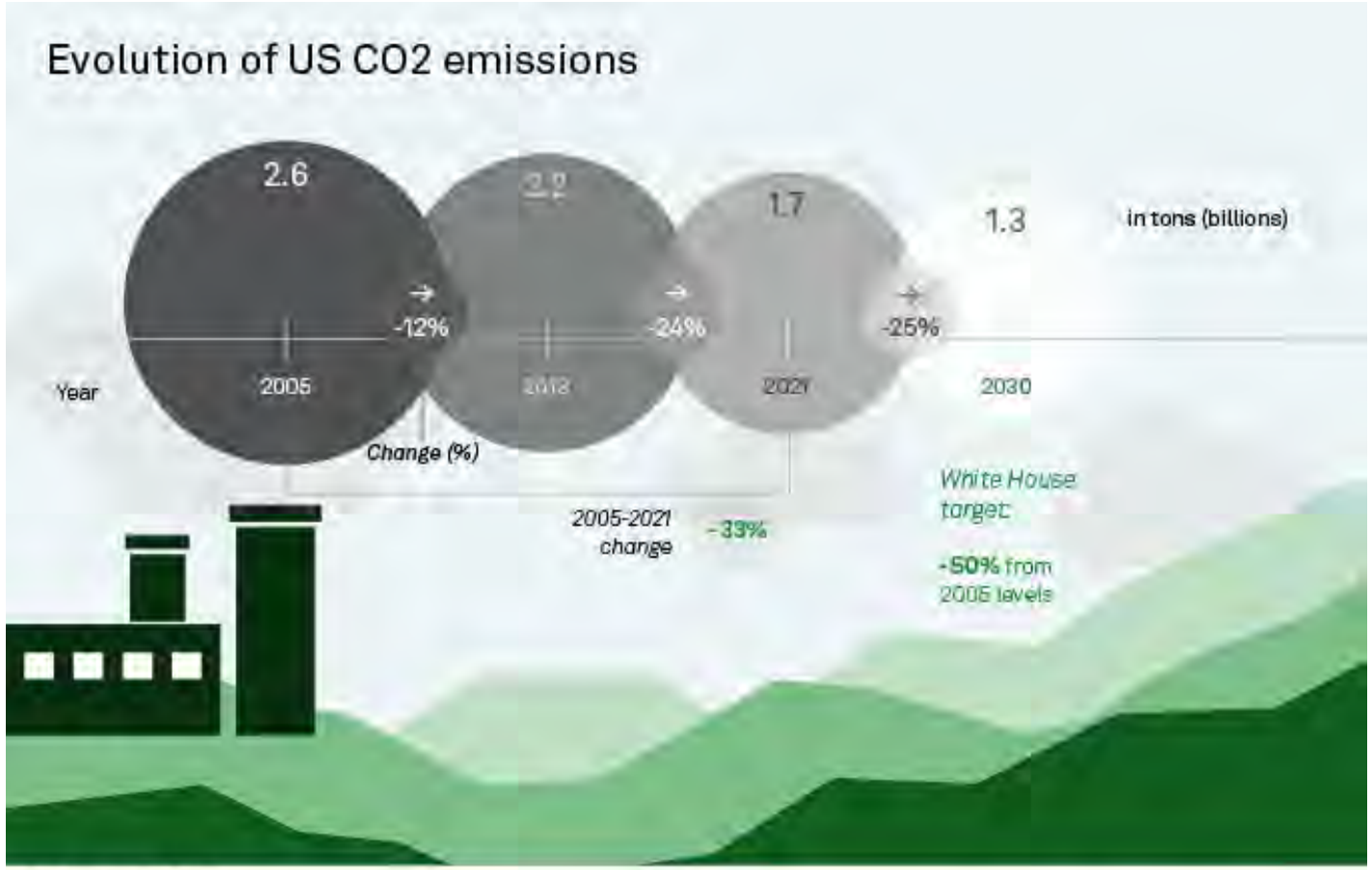
Externalities

- An economic side-effect.
- Externalities are costs or benefits arising from an economic activity that affect somebody other than the people engaged in the economic activity and are not reflected fully in prices.
- If it is a benefit the market will provide too little.
  - Answer: Tax or regulation
- If it is a cost the market will provide too much.
  - Answer: Subsidy
- Best outcome – include externalities in the costings of those engaged in the economic activity—so there is self-regulation (see pollution property right over clean air. The owner pays a fee—see Ronald Coase)

Externalities

- An externality is the cost or benefit that affects a third party who did not choose to incur that cost or benefit.
- The existence of externalities leads to a misallocation of resources
- The marginal social benefit/cost is greater than the marginal private benefit/cost
- Negative externality – putting discarded car parts on my lawn
- Positive externality – landscaping and maintaining my lawn

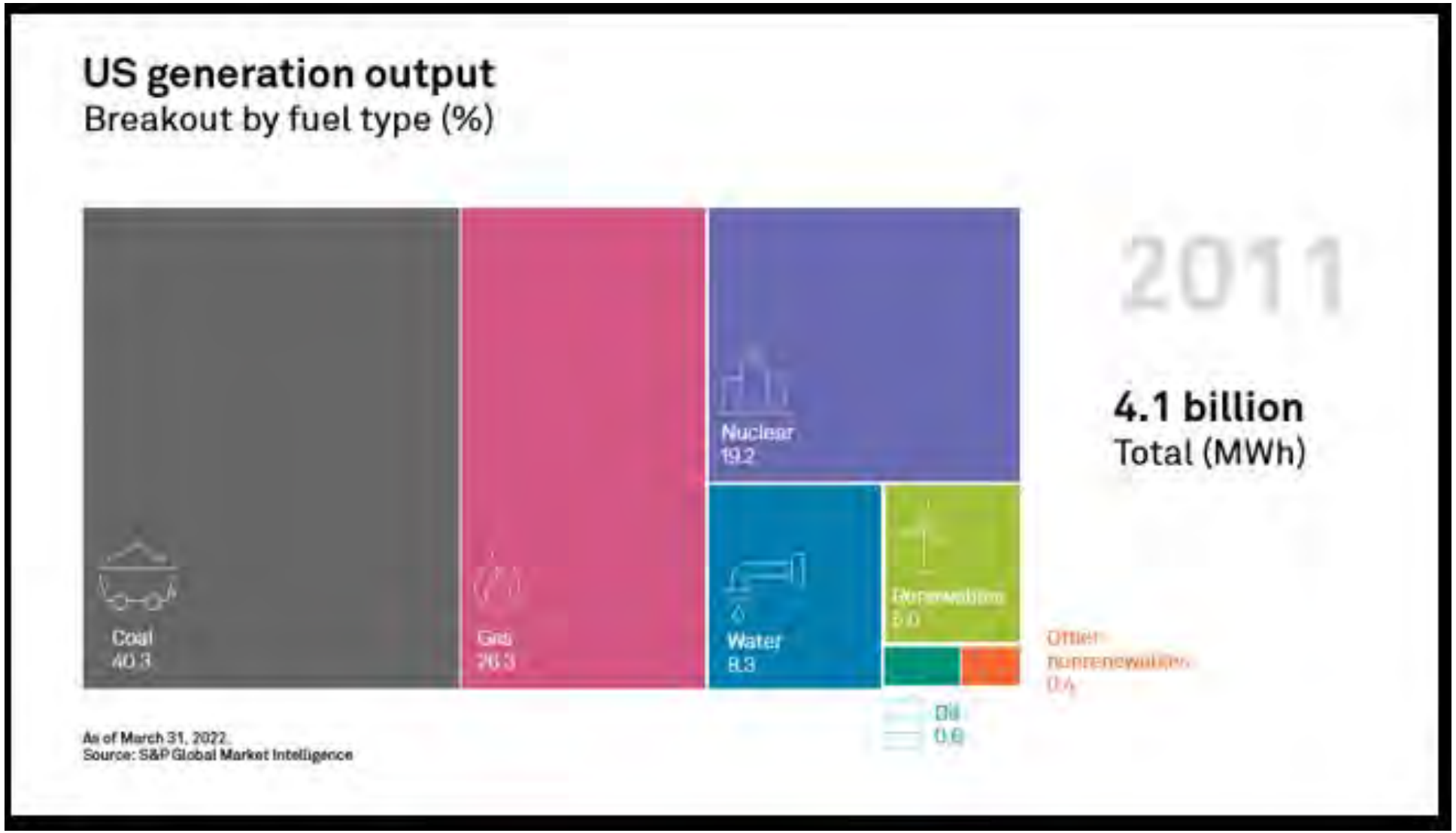
Visualizing 2005-2021 US CO2 emissions



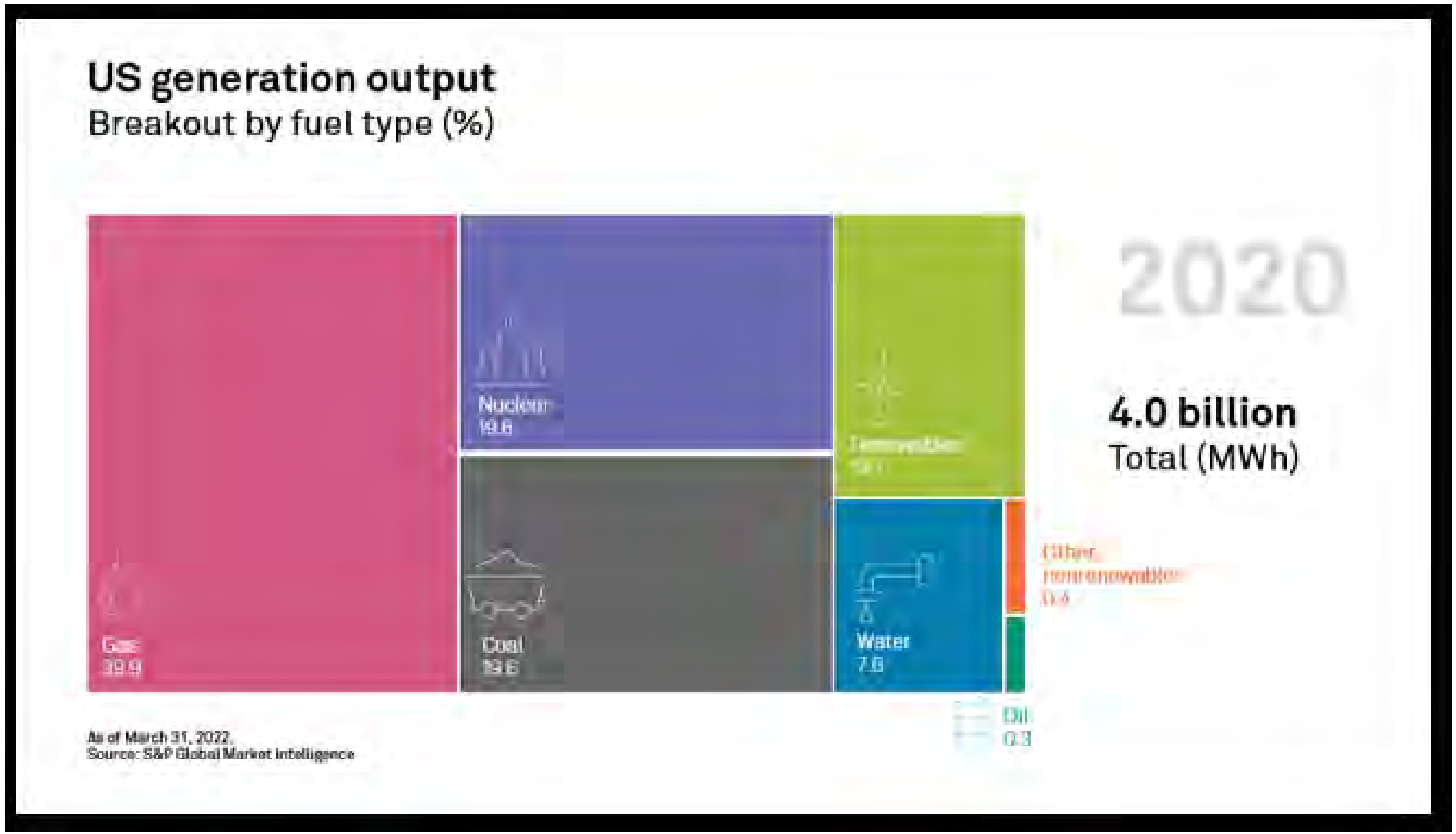
As of June 29, 2022.
Based on emissions data from EPA CEMS. Criteria to report to the EPA CEMS: All units over 25 MW and new units under 25 MW that use fuel with a sulfur content greater than 0.05 percent by weight are required to measure and report emissions to EPA under the Acid Rain Program. New units under 25 MW using clean fuels are required to certify their eligibility for an exemption every five years. A unit that formally committed to retirement before December 31, 1994 is exempt from the requirements of the rule.
Source: S&P Global Market Intelligence; U.S. Environmental Protection Agency Continuous Emissions Monitory System (CEMS)

CO2 emissions by U.S. utilities are down significantly since 2005, arguably aligning with long-term reduction goals to address climate change.

US Generation Output 2011



US Generation Output 2020



Capital Intensity… necessary investment or gold plating

Or, asking a barber if you need a haircut

Cost-of-Service Regulation

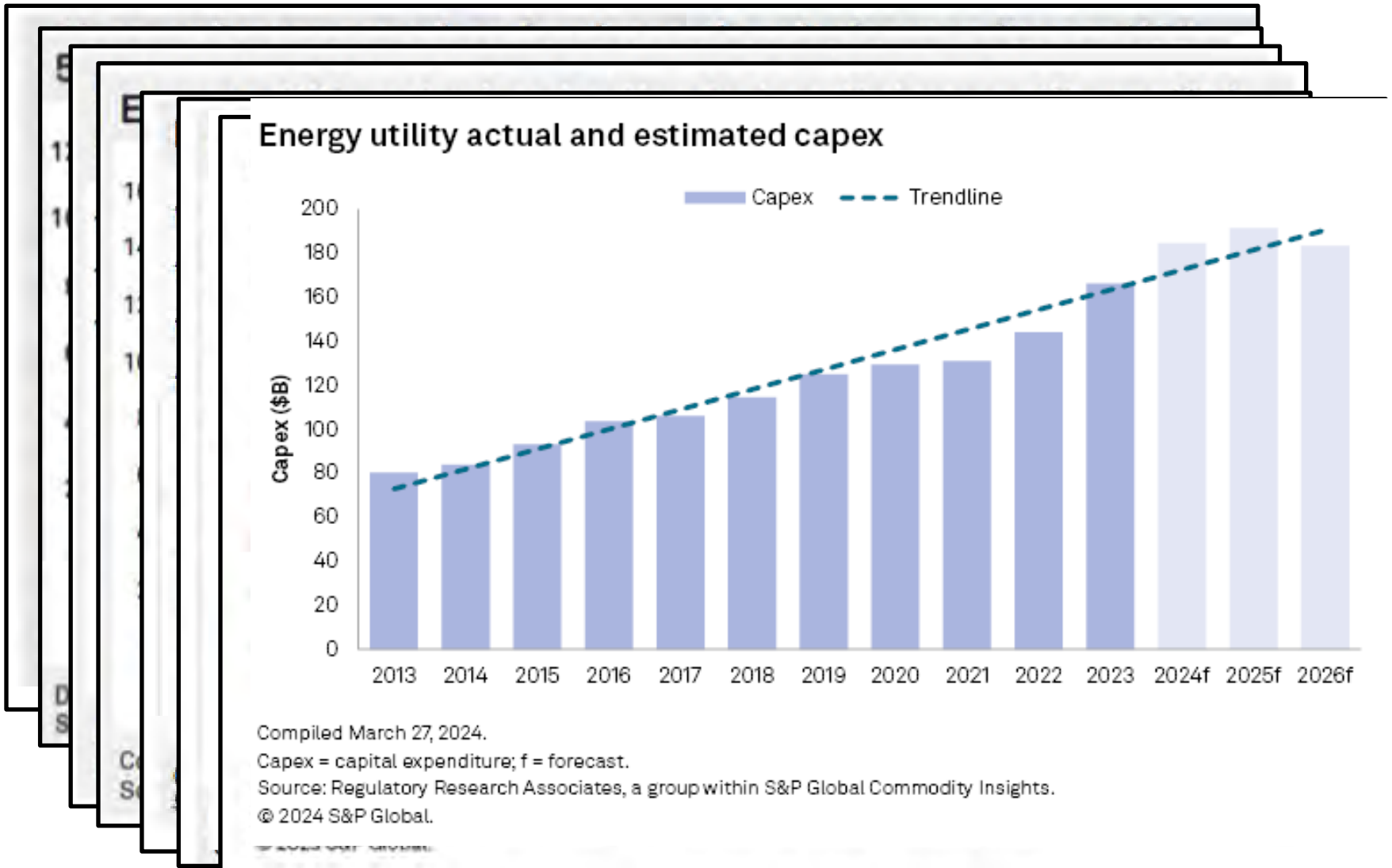
- Key utility-management hurdle is getting CAPEX included in rate-base

- Backward looking nature of COS regulation can impede utility efforts to innovate
- Apparent high risk related to investment in emerging technologies [ex post regulatory review]

- In actuality, difficult for regulators to identify (and disallow) all but the most obvious imprudent or wasteful investments CAPEX Rate-Base

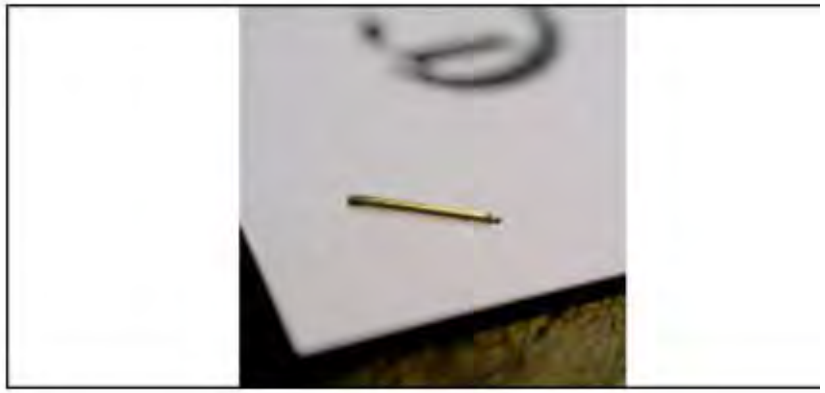
Energy utility actual & estimated capital expenditures (CapEx) ($B)

- Record, year-over-year capital spending



Averch-Johnson Effect "Gold plating"

- Congratulations! You are a regulated electric utility.
- You have a *guaranteed* (i.e., risk-free) rate of return for all capital investments in your rate base, on behalf of your kind ratepayers.
- Because you are *risk-free*, investors are happy to lend you money at low rates (say, 6%).
- Your *guaranteed* rate of return is consistent with market returns (say, 9 - 11%). How much capital investment do you want to make?
- The answer is, of course, "as much as possible!"



Goldplated Staples – $175

H. Averch and L. Johnson. "The Behavior of the Firm Under Regulatory Constraint," *American Economic Review*, December 1962.

- While rate of return regulation creates a highly stable environment for utilities, it also gives them incentives to make some *questionable* decisions, which costs consumers a lot of money.

- Averch and Johnson developed a model to illustrate that public regulation creates an incentive for the firm to over-invest in tangible assets.

- Since the "allowed profit" is based on the rate base, the firm has a perverse incentive to augment its capital stock.

- Over-investment (or over-capitalization) has obvious implications for rates paid by consumers and also for the efficiency of resource allocation.

Underground Distribution Investments Video

Dominion Proposal

- Deemed cost-effective by law up to a cost of $20,000 per undergrounded customer/$750,000 per mile
- 4,000 miles (directly benefitting only 6.9% of 2.25 million customers)
- $3 billion/$1,333 per customer, not including carrying charges
- Storm restoration reduction estimate: 40% (for 6.9% of customers to be undergrounded). So, a 10-day outage becomes 6 days.
- Statewide SAIDI improvement 3-12 minutes (2016 SAIDI: Dominion = 132 minutes; US IOU Average 120 minutes)
- No aesthetic benefit; 95% of poles/wires remain (telco, cable TV)

Source: Paul Alvarez, *Wired Group*

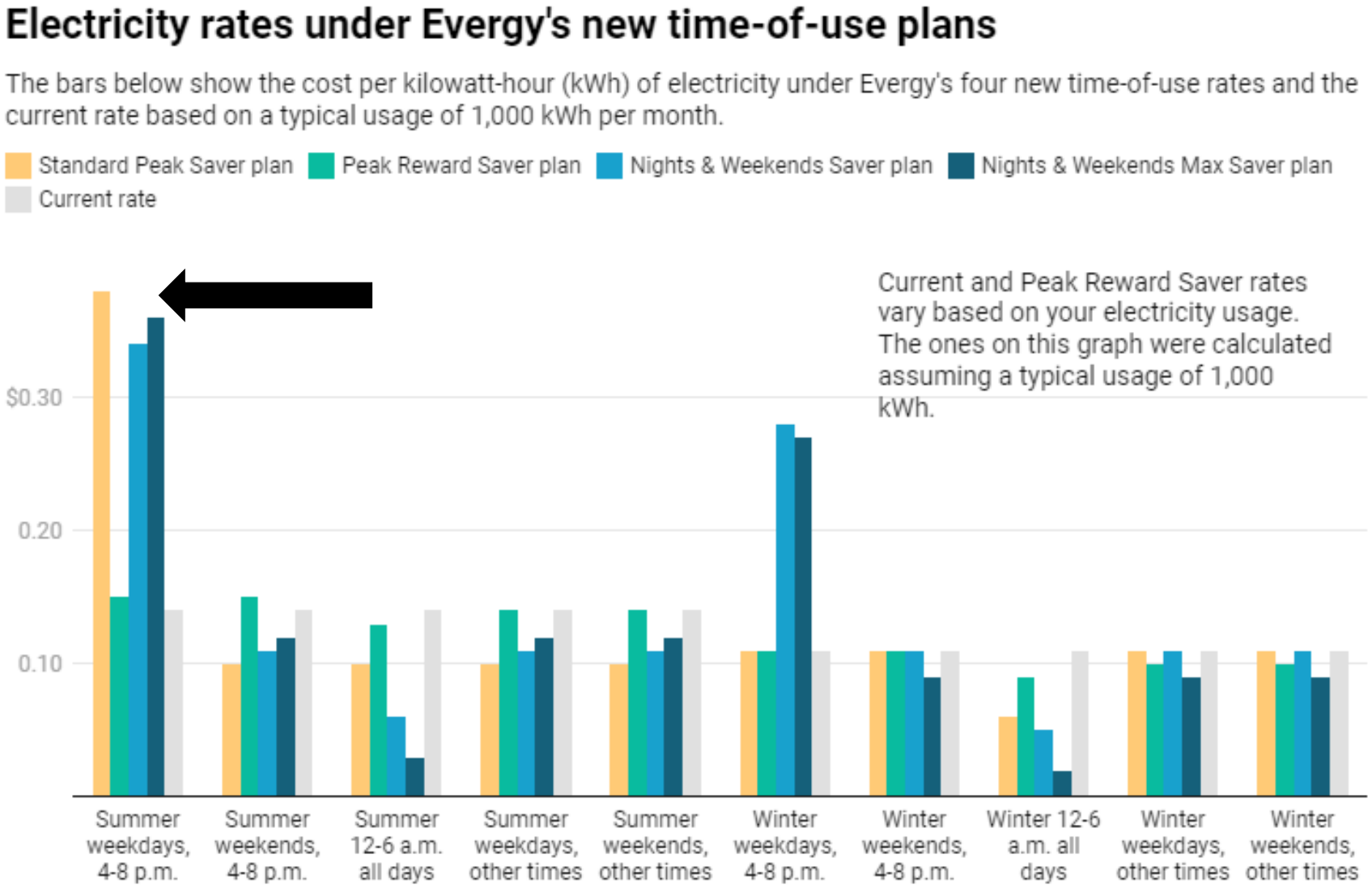
KCPL AMI Deployment

- AMI deployment 2014 – 2020 ($$$)
- AMI billing software ($$$)
- AMI TOU rates?
- 2023 at the earliest before new rates would go into effect
- Company will earn a return on and of its capital investment for at least 9 years before customers would receive the benefit of TOU pricing

Evergy AMI Deployment

- 2nd Generation AMI deployment 2020-2024
- remote/disconnect – loss of customer “door knock” provision
- New AMI billing software (7 year license)
- AMI TOU rates?
- Company seeking return on and of undepreciated balance and new investments.
- Customers paying for more than one meter and accompanying technology
- The result…

- Company’s new meters were found imprudent
- TOU of rates with high differentials are ~~to go into effect October 2023~~



MISSOURI INDEPENDENT

ENERGY + ENVIRONMENT GOVERNMENT + POLITICS

Missouri legislative leader files bill targeting time-of-use utility pricing plans

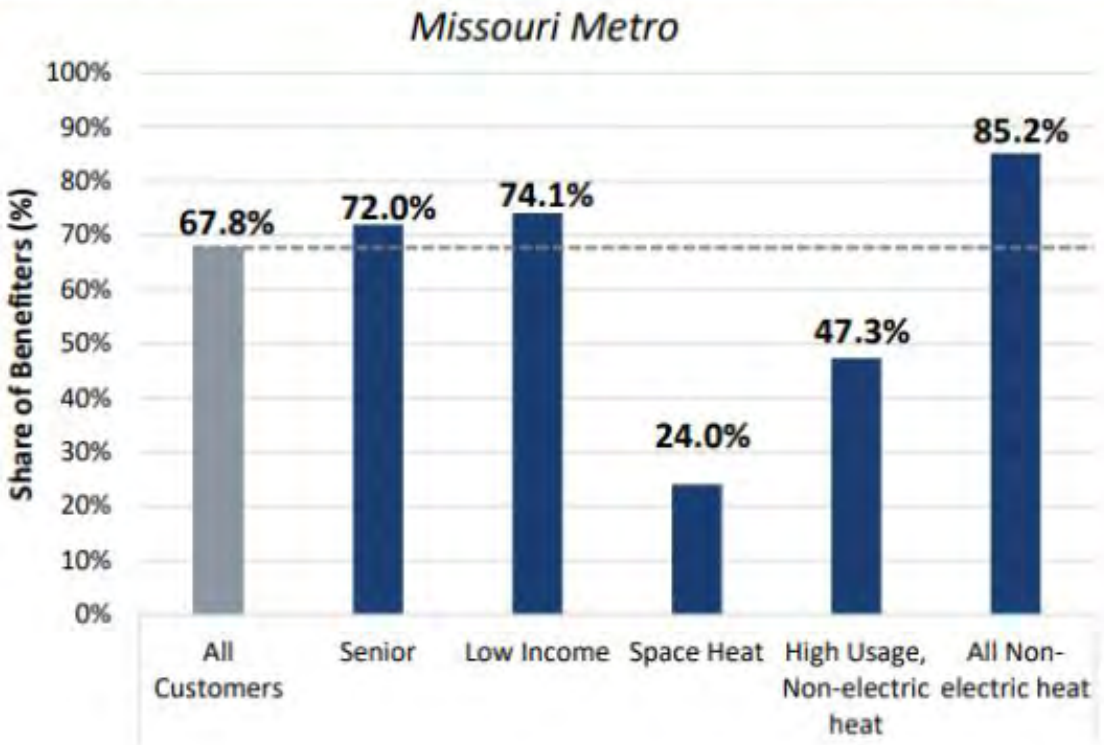
Senate Majority Leader Cindy O'Laughlin expects energy regulation to be a 'hot topic' in the upcoming legislative session

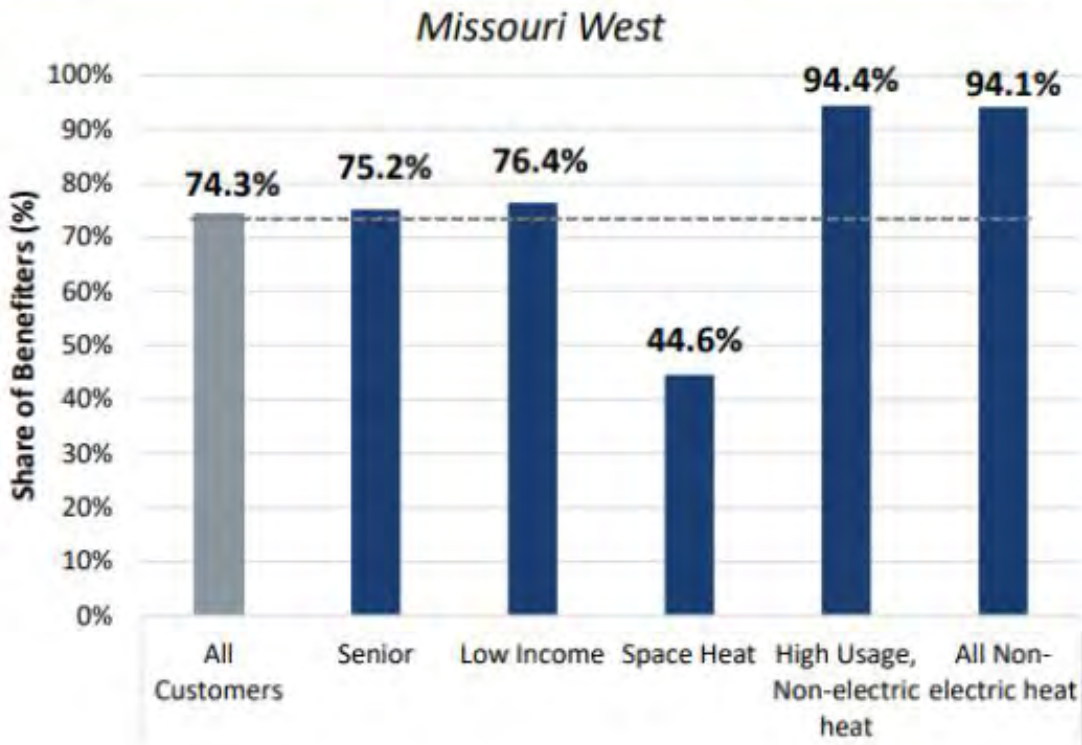
BY: **ALLISON KITE** - DECEMBER 19, 2023 9:00 AM

Default TOU bill impacts by customer segment

Senior and low income customers are more likely to benefit on the 2-period rate than other customers. Electric heating customers often experience bill increases on the new TOU rate.

Share of Customers Benefiting when Moving from Standard Non-TOU Rate to Default 2-Period TOU Rate





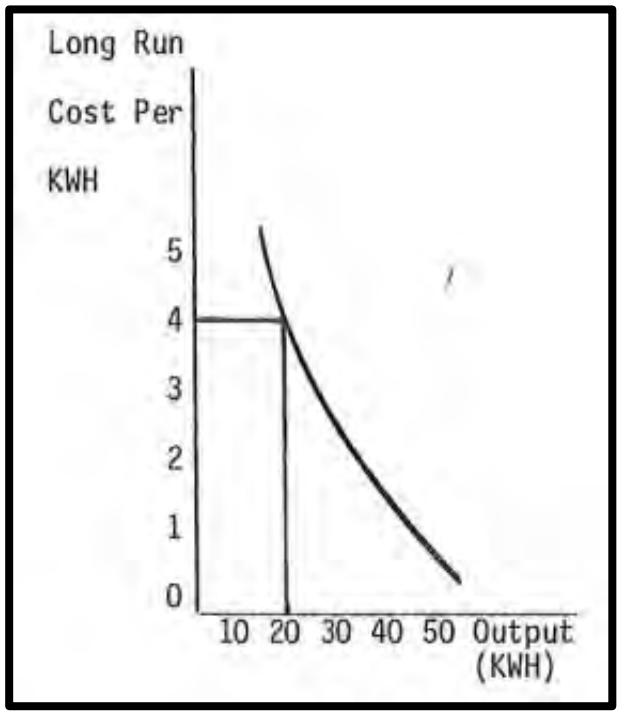
Economies of Scale and Scope (and consolidation)

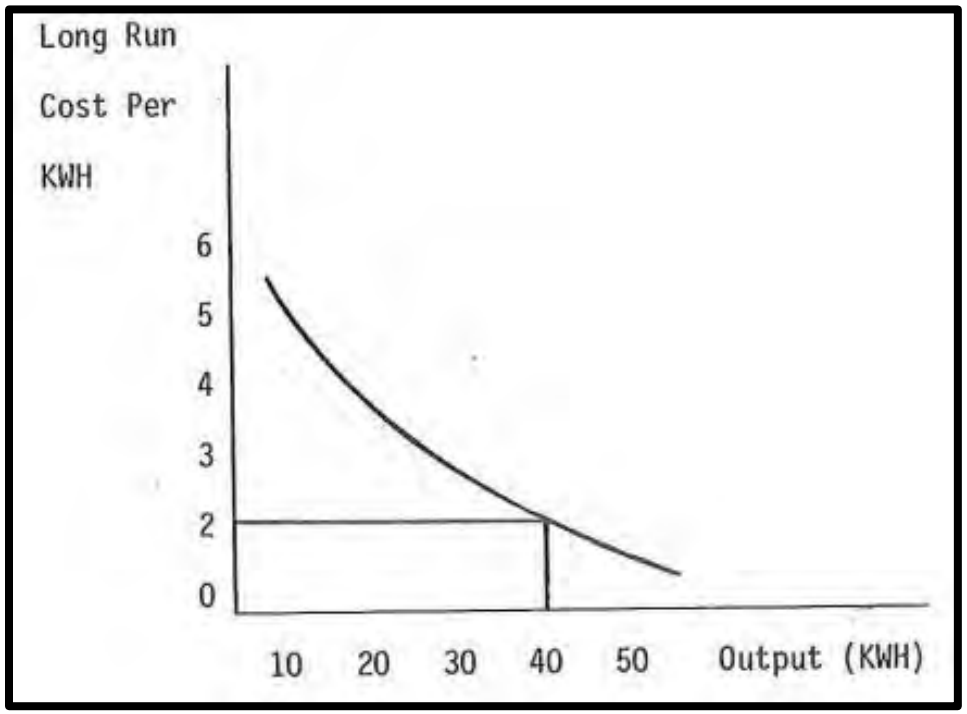
Economies of Scale

- Cost advantages gained from size.
- The economic principle is that, as the size of the utility grows, its long-run average costs will fall as its costs are spread across a larger denominator (e.g., customer base or MW of generation).
- Though scale economies are apparent, **they are neither absolute nor unlimited**.

Economies of Scale: Generation

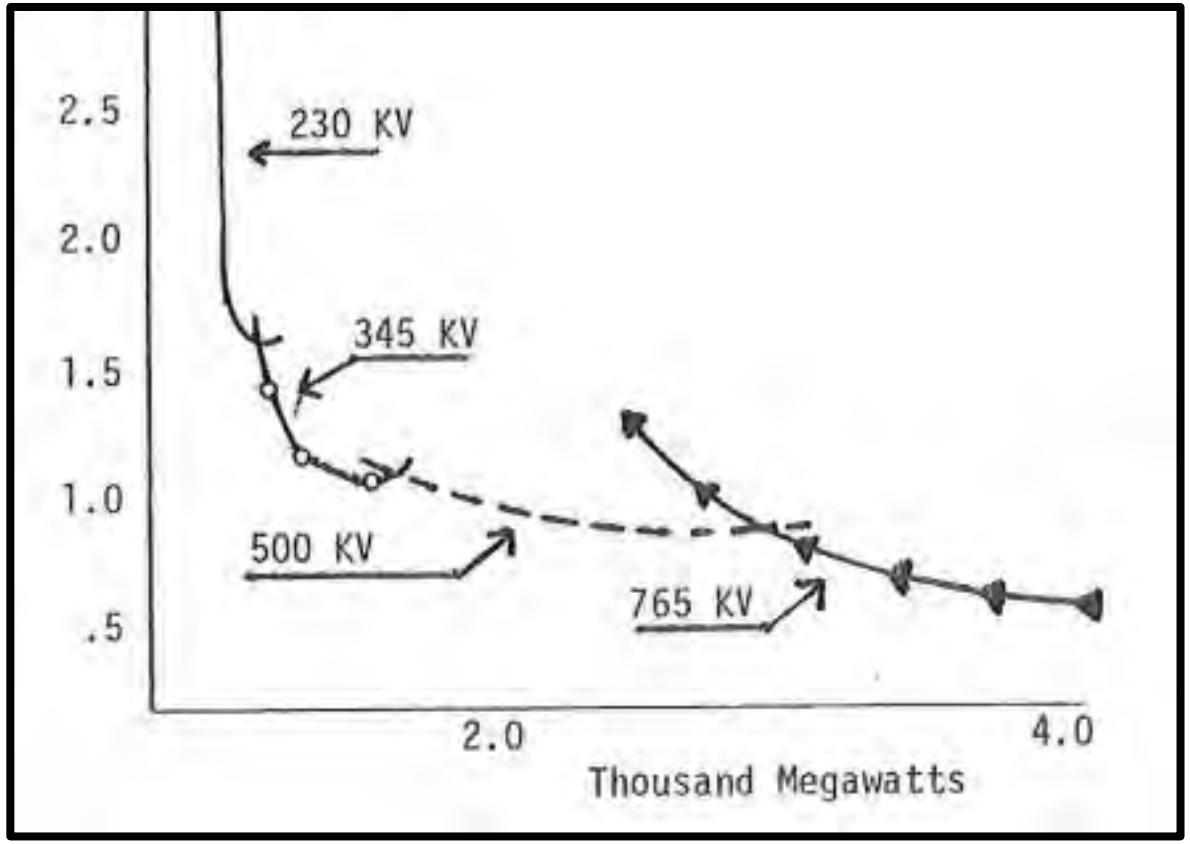
- The average cost of production decreases as production increases

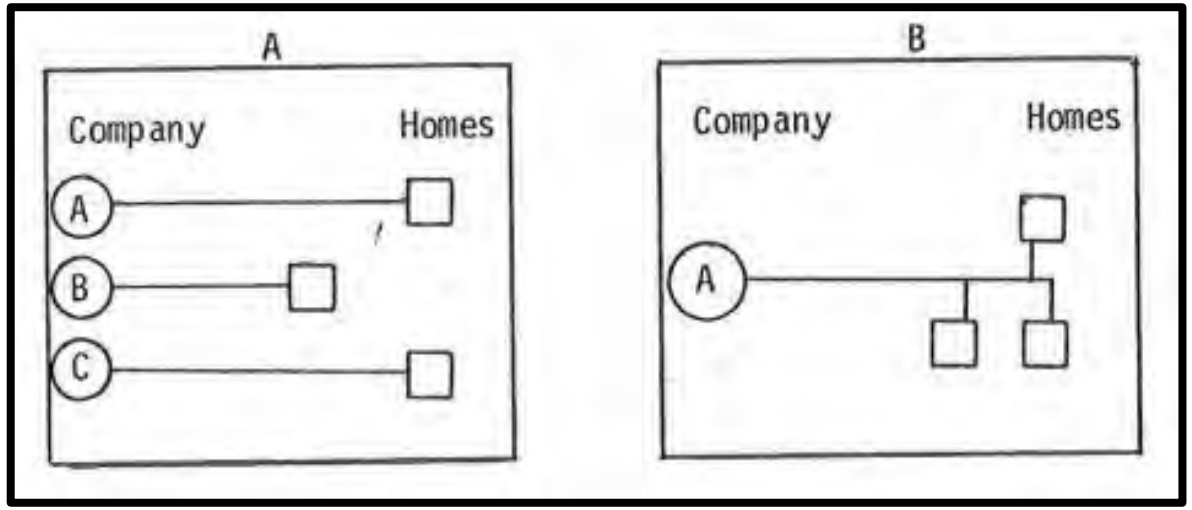




- Those who argue that the electric industry is a decreasing cost industry mean that it experiences economies of scale over the entire range of its long run average cost curve.

Economies of Scale: Transmission and Distribution

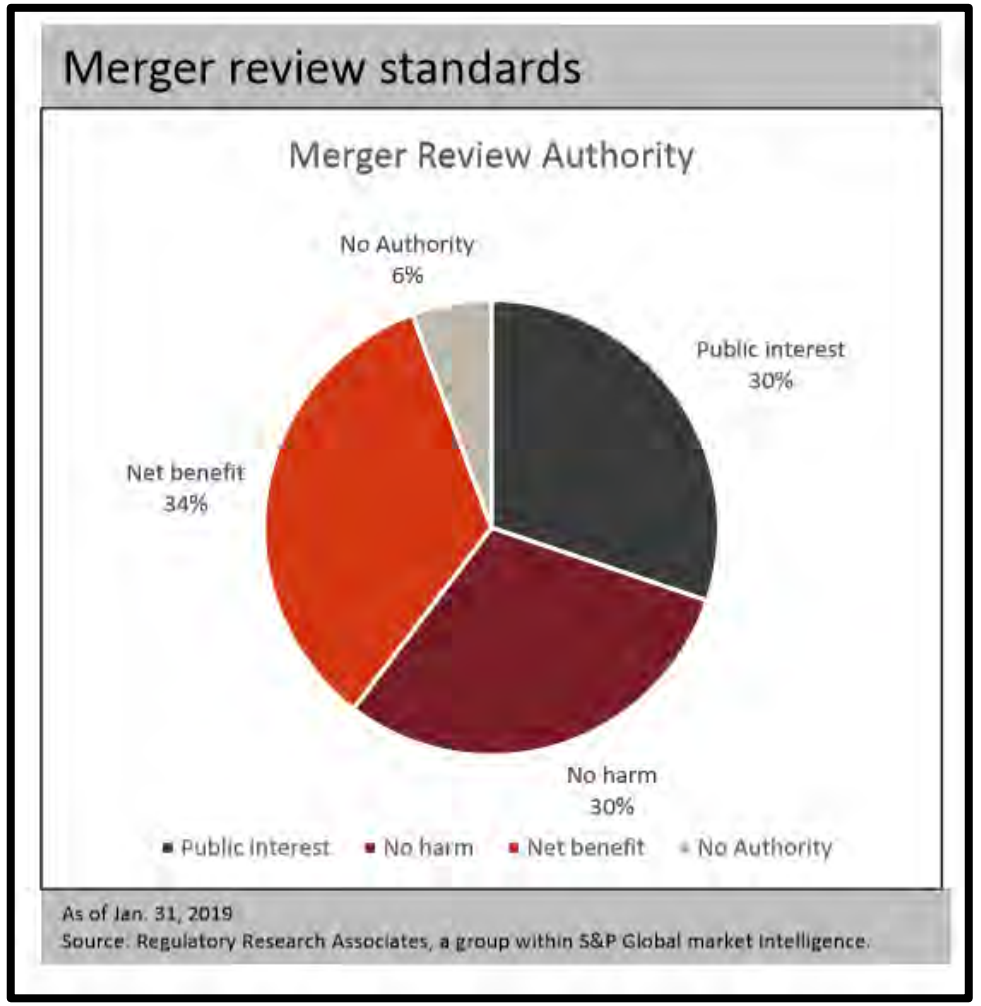




- Need to meet requirements above *and* be affected with a public interest – or those with an inelastic demand

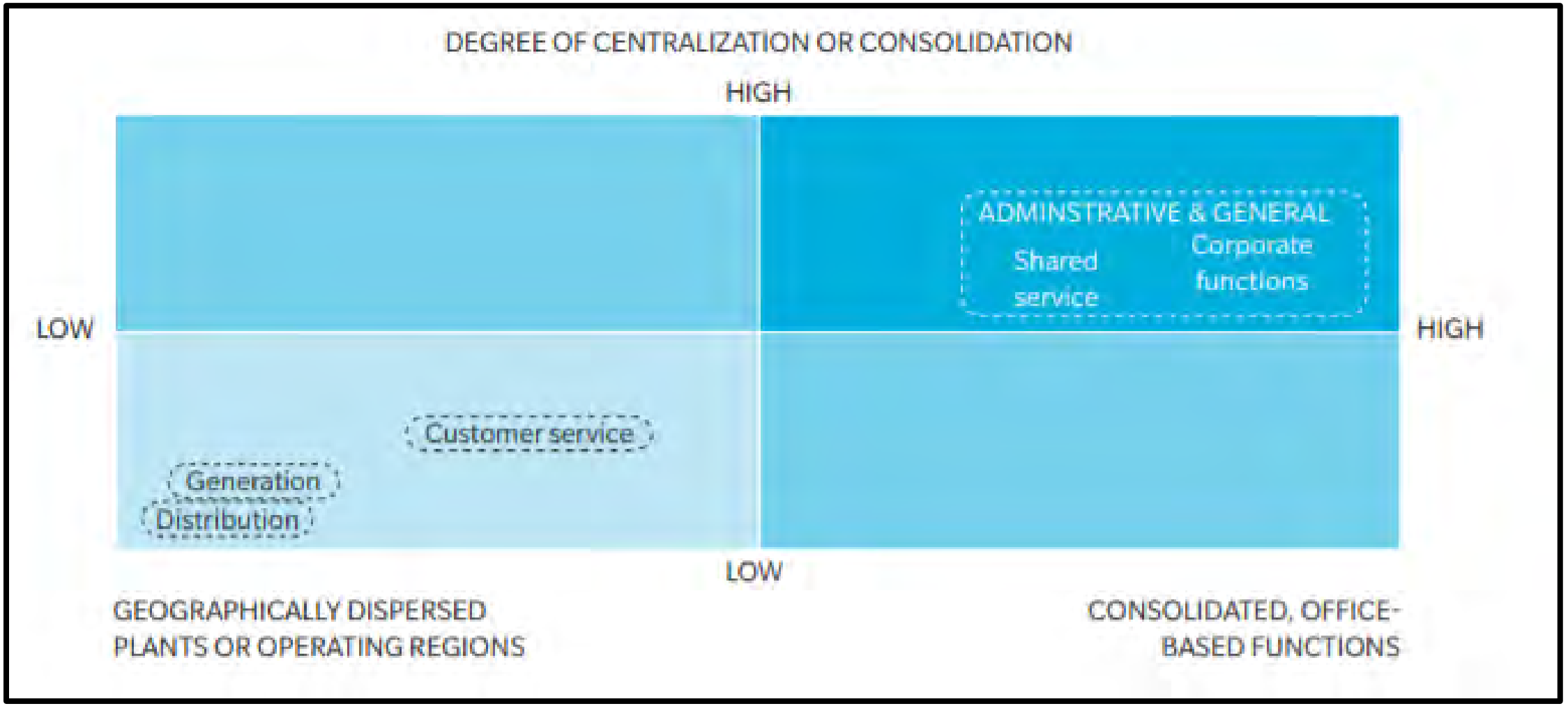
Another "scale" example: Mergers and Acquisitions

- **Standards**
- Public Interest
- Net ratepayer benefit
- No net harm



- **Issues**
- Rate impacts
- Operating performance
- Service quality
- Competition
- Corporate structure
- Financial viability
- Impact on local economy
- Credit quality
- Bankruptcy exposure

Expected impacts of economies of scale in mergers/consolidations



Arguments for

Economies of scale

- **Bulk buying and negotiating**: Wal-Mart strategy
- **Reduce G&A**: corporate support function decrease (legal, admin, etc…)
- **Technical**: capital investments minimize O&M
- **Risk reduction**: bigger firms are better insulated from downturns
- **Specialization**: division of labor within production
- **Financial**: better ratings
- **Marketing**: advertising not directly tied to quantity produced

And against

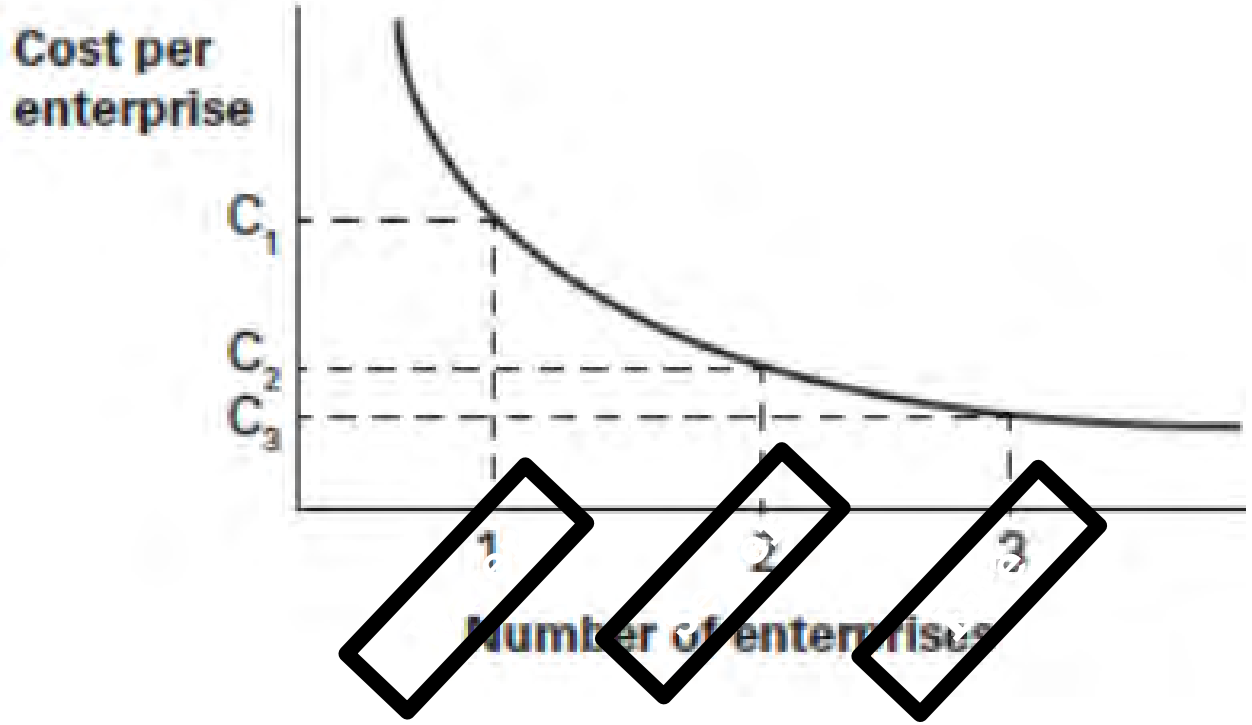
Diseconomies of scale

- Overstated savings
- New costs can offset gains (e.g. new power savings offset by transmission costs)
- Managerial mismanagement

- Satellite offices lose local presence
- Affiliate transaction concerns

Economies of Scope

- Economies of scope arise when a firm can lower average costs by producing more than one type of good, rather than the economies of scale that arise from lowering average costs by producing higher quantities of the same good.



- Scope economies are realized through vertical integration of functions (generation, transmission, and distribution) and horizontal integration of complementary operations (electricity and gas).
- Free Market example:

Consolidations

- The promise of significant further economies of scale has underpinned the business rationale of significant consolidation in the utility industry.

- Particularly in the water industry
  - Single-Tariff pricing

Arguments for water consolidation

- Minimize rate shock (spread costs around)
- Minimize EPA compliance costs (see above)
- Incentivize Acquisitions (distressed systems)
- Rate Case Expense (fewer cost studies)
- Simplify allocation of Corporate Costs
- Similar Operations
- Equivalent Services (provide water)
- Economic Growth (also tied to acquisitions)
- Consistent approach across utilities (see also electric and gas)

Arguments against water consolidation

- Water service is local
- The principles of cost causation in rate making
- Inappropriate price signal to consumers
- Overinvestment of infrastructure
- Exacerbates asymmetric information
- Consolidation of water and sewer services can be misaligned (e.g., water customers subsidizing somebody's sewer service when they pay a separate company for sewer)

Cost Causation?

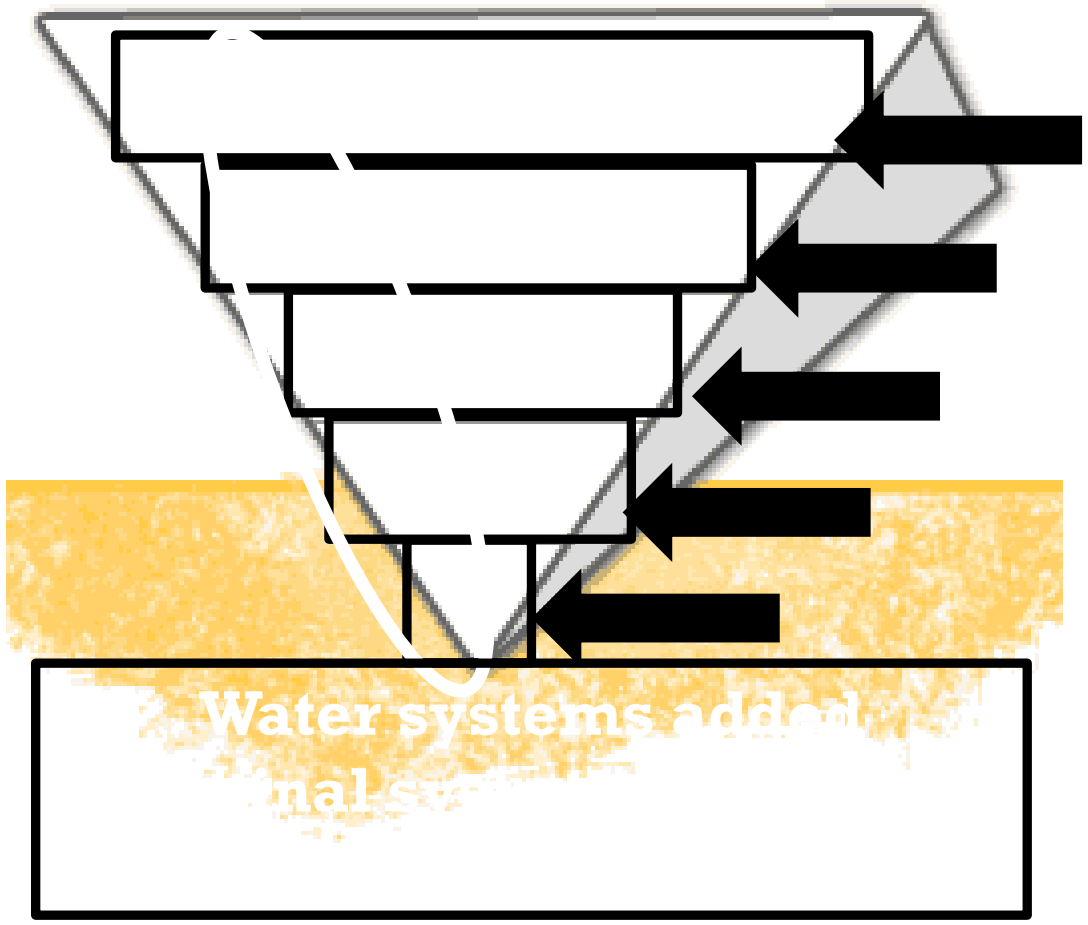
- Apportion costs to the cost causer that receives the service and that causes the costs to be incurred…

To illustrate just how distant these two service areas are from one another, consider that St. Louis Metro is closer in proximity to all of the following cities:

- Chicago IL - 296.7 miles (via I-55)[9]
- Memphis, TN - 283.3 miles (via I-55)[10]
- Iowa City, IA - 259.7 miles (via US-218 and US-61)[11]
- Louisville, KY - 259.9 miles (via I-64)[12]
- Kansas City, KA - 251.0 miles (via I-70)[13]
- Indianapolis, IN - 243.3 miles (via I-70)[14]

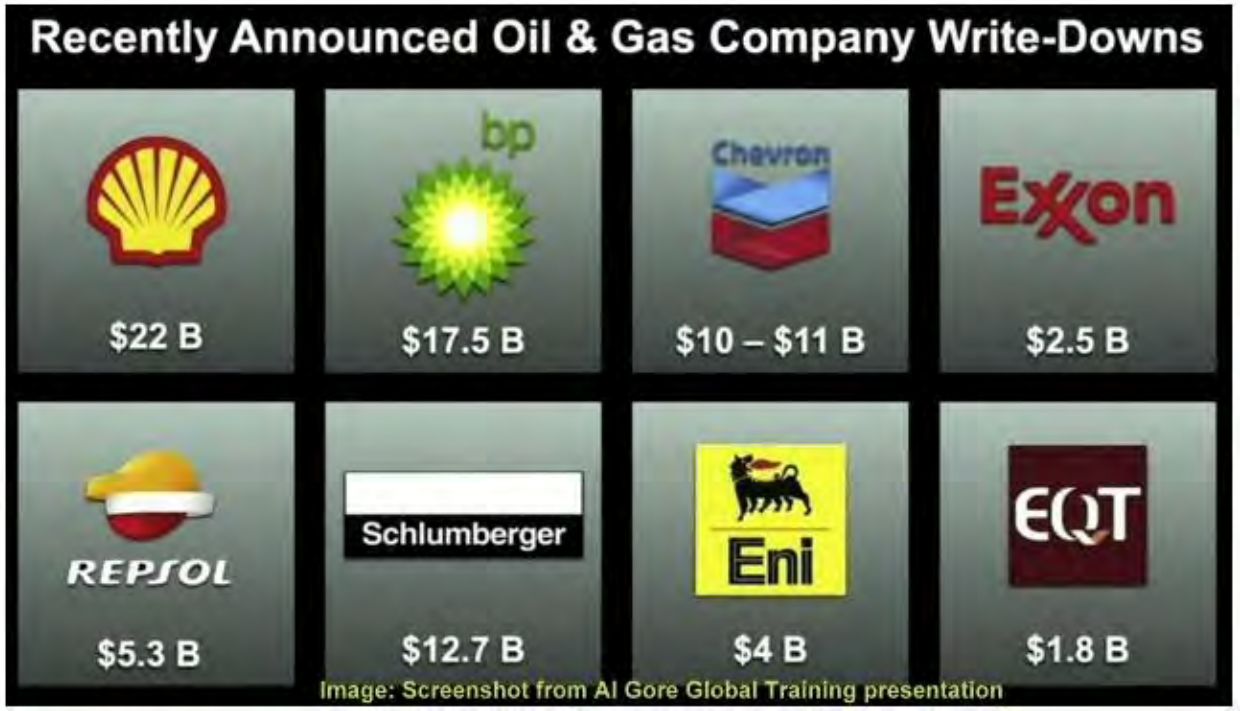
It’s all about the rate base…

- According to American Water’s 10-K filing:
- *An important part of our growth strategy is the acquisition of water and wastewater systems . . . We compete with governmental entities, other regulated utilities, and strategic and financial buyers, for acquisition opportunities.*



Stranded Assets

- Assets become stranded if their expected cash flow is less than their remaining book value.
- That is, if the asset is expected to make less money before the end of its useful life than it will cost over the same period.
- Example of a **market-based stranded asset**:
- An oil reserve has a $1 billion book value but sliding demand due to carbon taxes reduces its market value to $400 million. The result is $600 million in stranded assets.
- Markets, in turn, will price in the risk of asset write-downs.



S&P Global
Market Intelligence

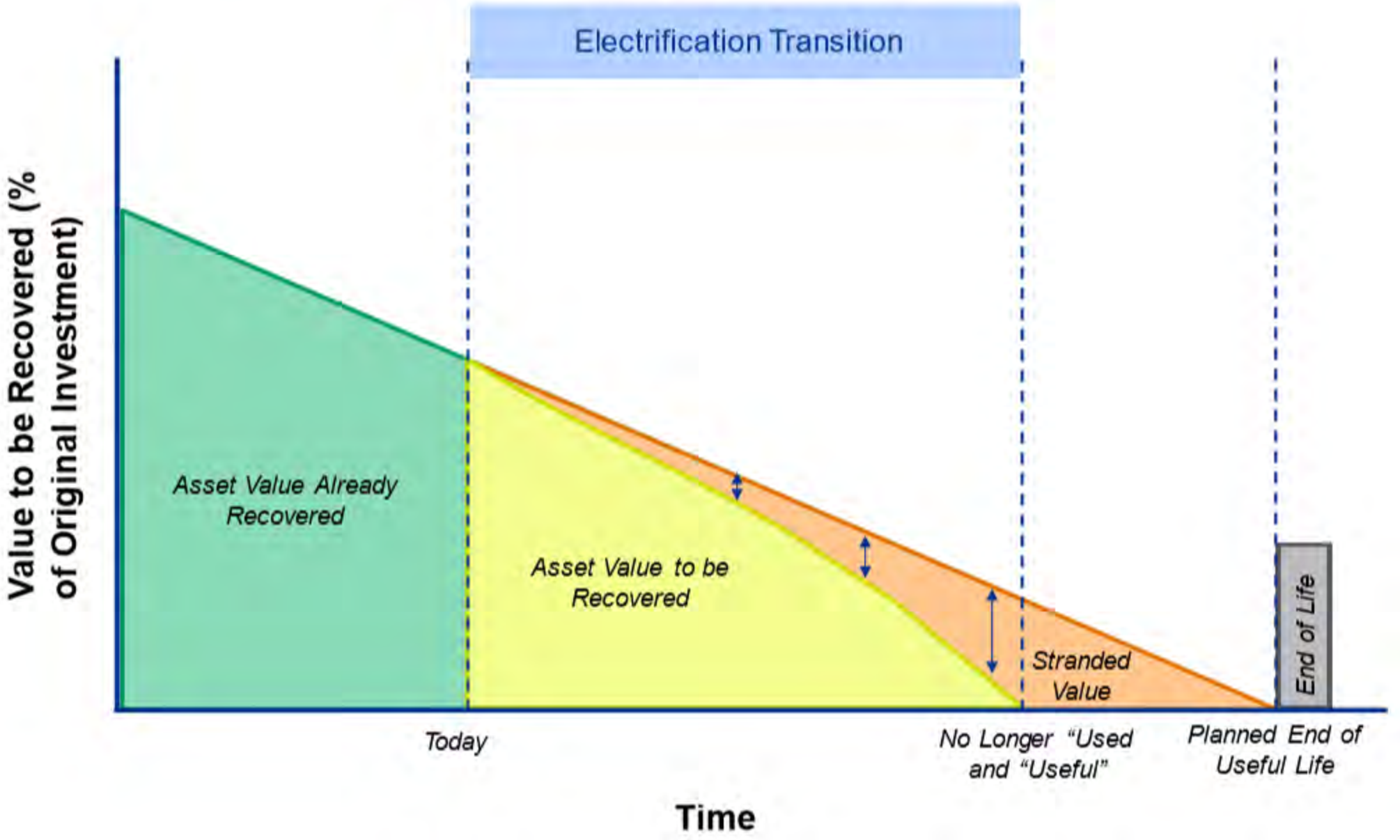
FINANCIAL FOCUS

A nationwide push for green energy could strand $68B in coal, gas assets

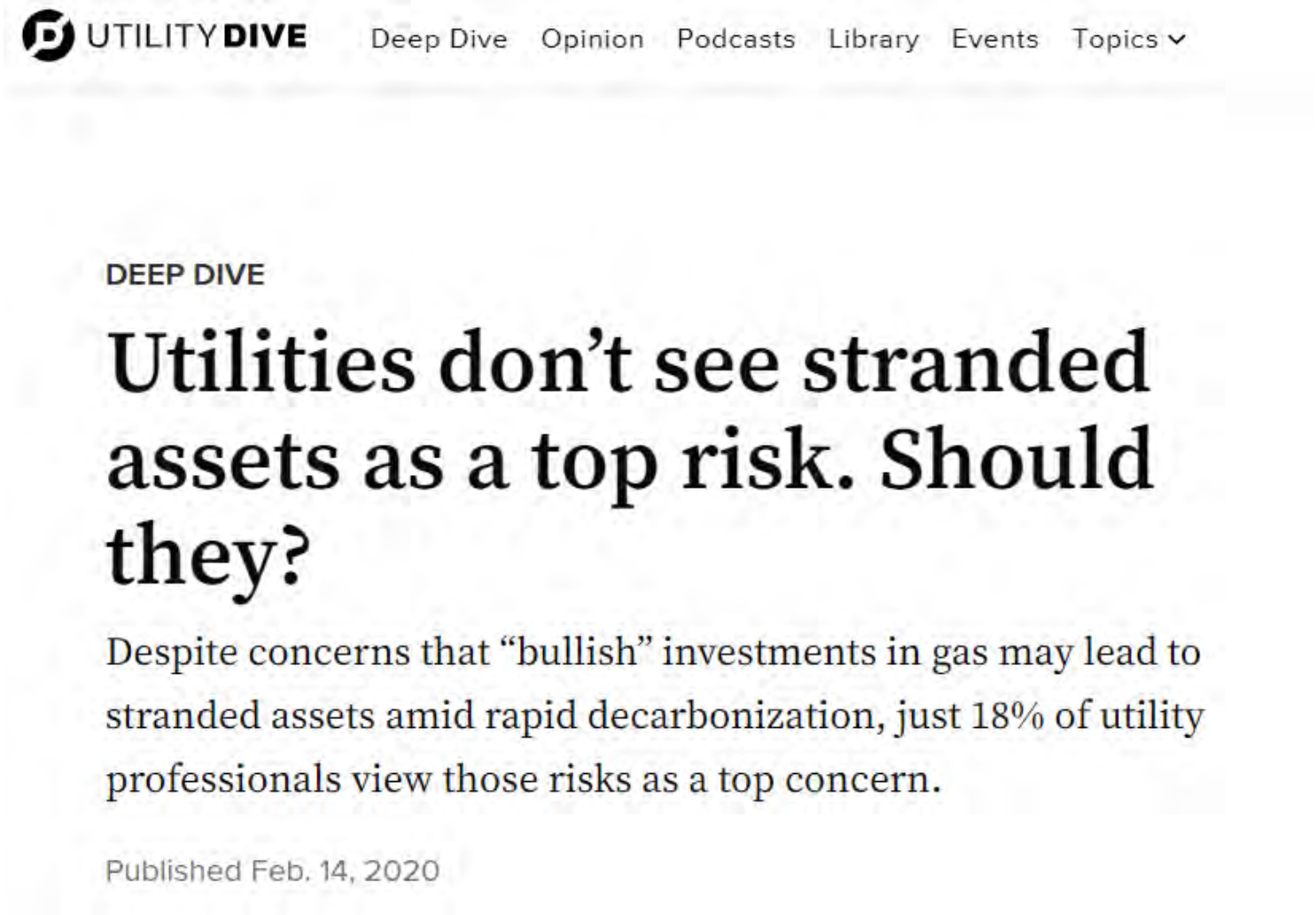
Thursday, August 5, 2021 8:31 AM ET

By Adam Wilson and Steve Piper
Market Intelligence

Overview of Stranded Asset Value for Investments



Would a utility want to strand an asset?



- Regulation-based stranded asset:
- The asset has been explicitly approved by government regulators at some point in the past to earn a return over a defined period of time.
- The question becomes whether or not the remaining book value (return of) and expected profit (return on) remains on the books; or
- Is it fair for a power plant that is not generating power to benefit its customers be allowed to continue generating profit for its shareholders?
- And who should eat the remaining balance?

Do “large-scale” cost disallowances impact future investments?

- Writing in *the RAND Journal of Economics*, economists Thomas Lyon and John Mayo examined large scale cost disallowances levied by state regulators on electric utilities during the 1980s and the subsequent investment propensity of all firms—both those that faced cost disallowances and those that did not. Lyon and Mayo concluded:

  - *Our results indicate that a utility that suffers a regulatory cost disallowance does subsequently invest less. Other utilities in the same state, however, show no significant reduction in investment, indicating that disallowances were interpreted as punishment of company-specific managerial excess rather than an abrogation of the regulatory contract.*

Lyon, T.P. & J.W. Mayo (2005) Regulatory opportunism and investment behavior: evidence from the U.S. electric utility industry. *RAND Journal of Economics* 35, 3. Autumn p. 628-644.

Behavioral Economics:
Anchoring
Narrow Framing
Halo Effect

- Anchoring: in which an individual's judgments or decisions are influenced by a reference point or "anchor" which can be completely irrelevant.
    - Company asked for $500M and the Commission awarded $400M. They saved $100M!

- Narrow Framing: A tendency to see investments without considering the context of the overall portfolio.
    - Single-issue ratemaking

- Halo Effect: A cognitive bias which can prevent someone rom forming an image of a person, a product or a brand based on the sum of all objective circumstances at hand.
    - Company wants to promote a low-income rate to the public

Regulatory failure: Moral Hazard and Regulatory Capture

Moral Hazard

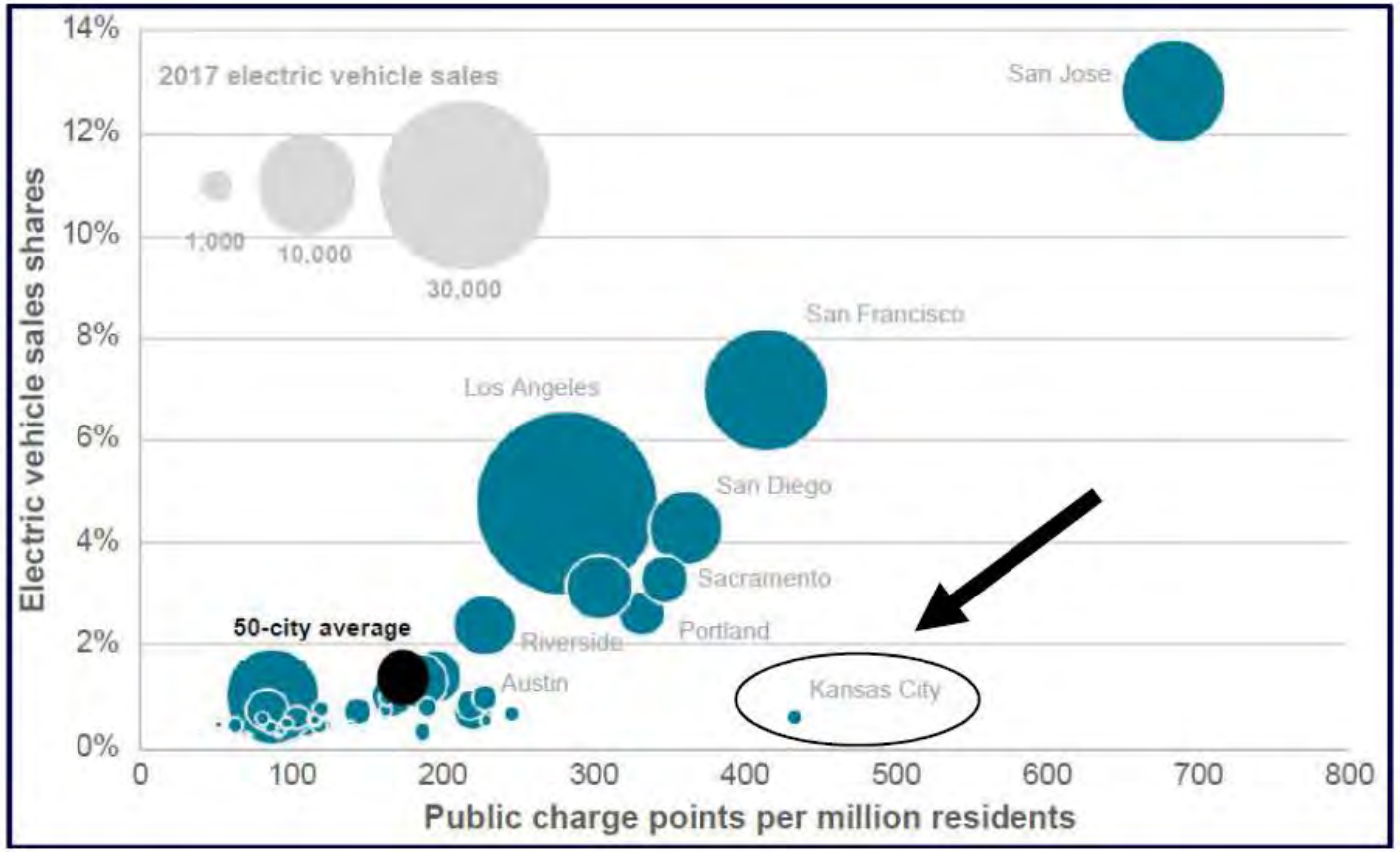
- Moral hazard is the term for a situation where one party takes high risks knowing they are protected from the consequences which will fall upon another party.

- Regulatory examples:
- Fuel hedging
- EV charging stations

- Best way to counter moral hazard: skin-in-the-game or at least a performance standard

EV Uptake and Charging Infrastructure in US ‘EV Capitals

- **<u>EV Charging Station options</u>**
- 1.) Free market
- 2.) Utility Control
- 3.) Risk-Reward based on metric
- 4.) Funding based on usage
- 5.) Do nothing
- **<u>Problems</u>**
- 1.) Stranded assets
- 2.) Opportunity costs
- 3.) Economic and social impact



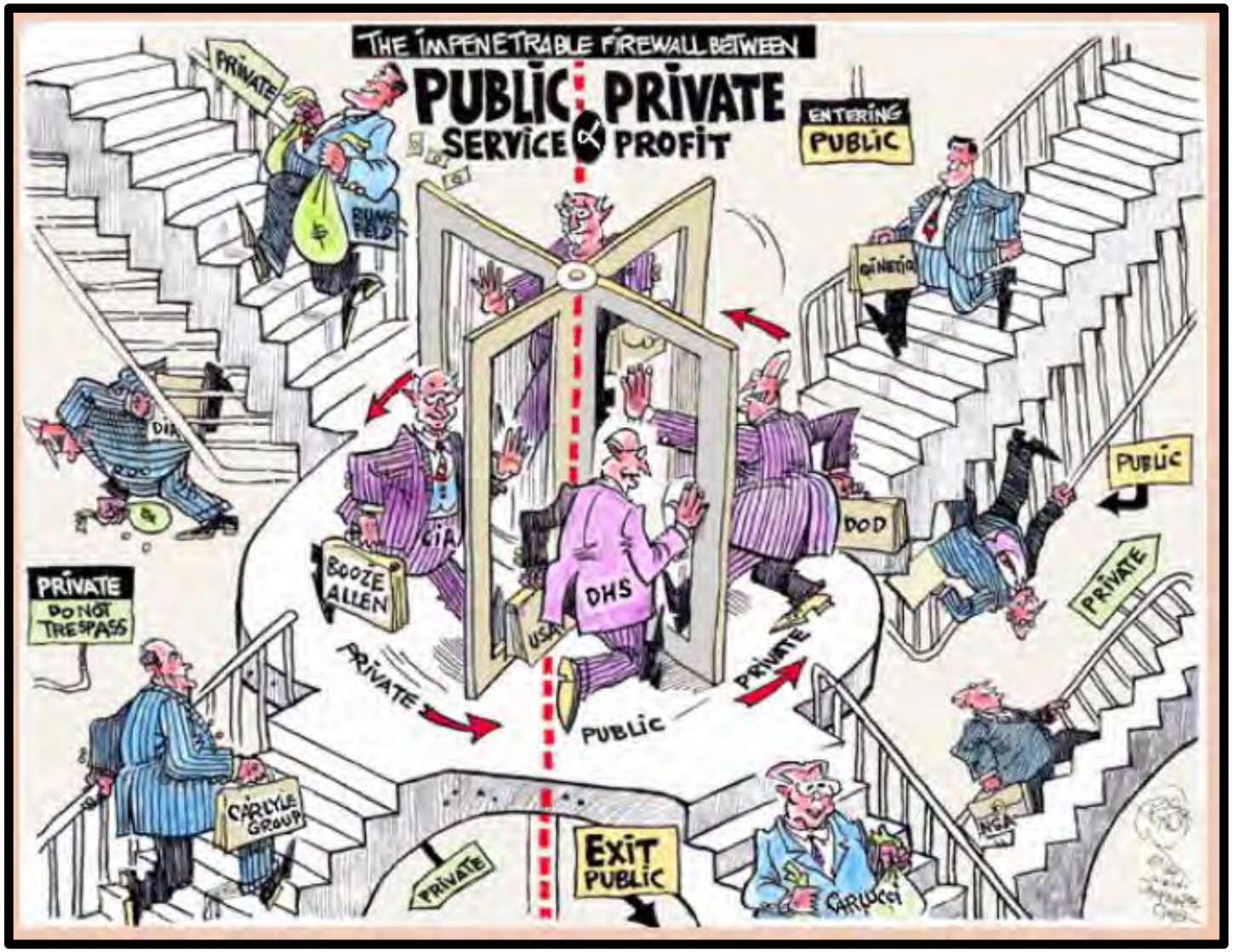
Liberty "Level Up" EV Charging Station

- Initial seed money

- Three levels of additional funding if total consumption increased above the reference level at least 60% over the most recent six months of usage

Phase of Funding Release	Maximum Funding Amount (Totex)	Applicable Conditions	Charging Equipment Cost Responsibility
Initial: Program Launch	$500,000	PSC Approves Ready Charge Program Tariff.	100% customer base recovered net of the initial participant deposit.
Level Up Tranche 1	$833,333	25% consumption increase (total kWh) above reference level across at least 60% of Public Chargers over the most recent six months of usage.	80% Missouri customer base recovered net of the 20% participant contributions per charger recovered through the combination of an initial participant deposit and monthly fixed charges.
Level Up Tranche 2	$833,333	20% consumption increase (total kWh) above Tranche 1 qualifying consumption level across at least 60% of Public Chargers over the most recent six months of usage.	80% Missouri customer base recovered net of the 20% participant contributions per charger recovered through the combination of an initial participant deposit and monthly fixed charges.
Level Up Tranche 3	$833,333	20% consumption increase (total kWh) above Tranche 2 qualifying consumption level across at least 60% of Public Chargers over the most recent six months of usage.	80% Missouri customer base recovered net of the 20% participant contributions per charger recovered through the combination of an initial participant deposit and monthly fixed charges.
Total Maximum	**$3,000,000**	-	-

Regulatory Capture



Economic Caution: Regulatory Capture

- Gamekeeper turns poacher or, at least, helps poacher. The theory of regulatory capture was set out by Richard Posner, an economist and lawyer at the U. of Chicago, who argued that

- *"Regulation is not about the public interest at all, but is a process, by which interest groups seek to promote their private interest…Over time, regulatory agencies come to be dominated by the industries regulated."*

- Capture can take various forms: subsidies, control of entry by competitors, and price-setting, among others.

- George Stigler: “as a general rule, regulation is acquired by the industry and is designed and operated for its benefit.”

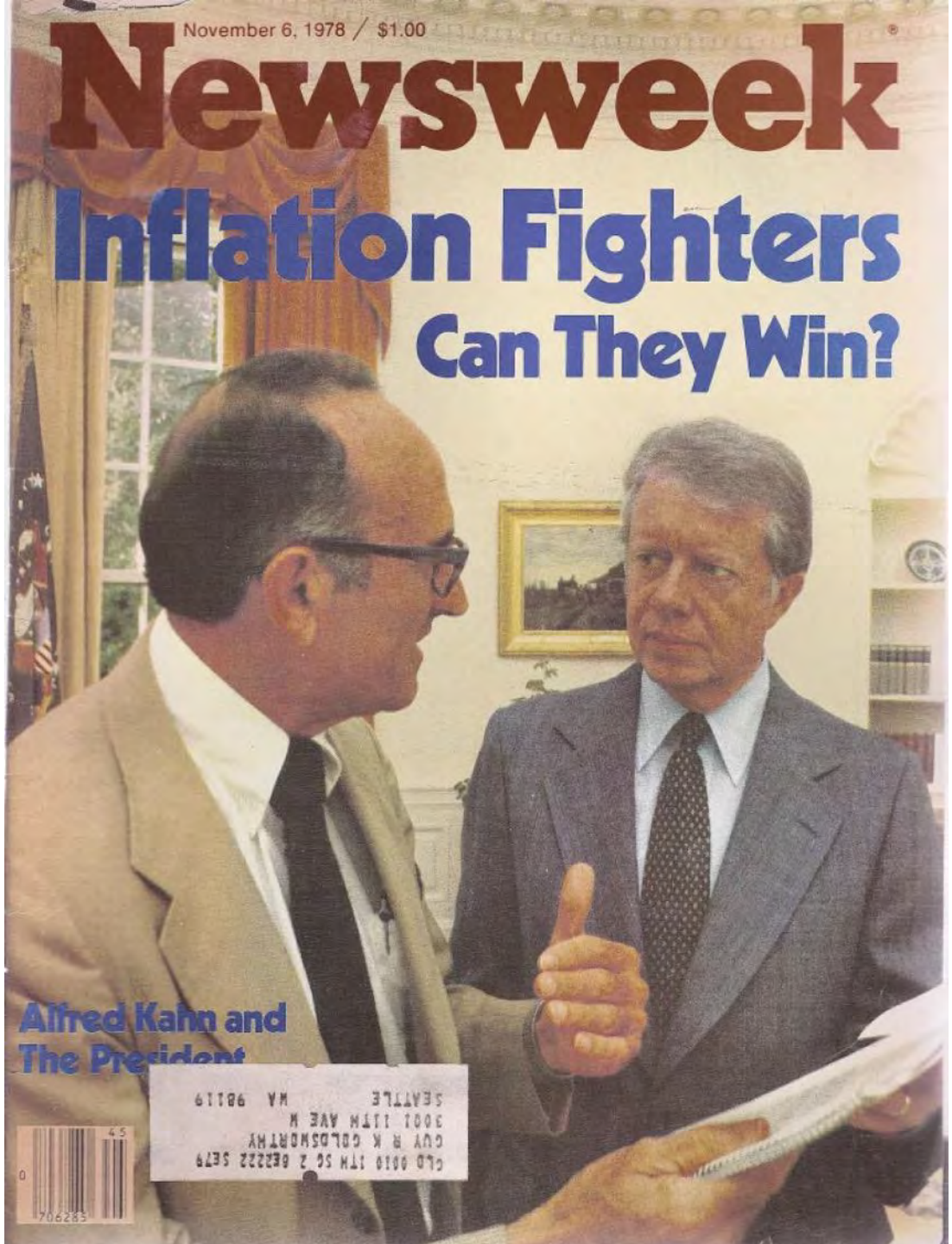
- Most economists are less extreme arguing that regulation often does good but is always at risk of being captured by the regulated firms.

- An essential insight of Stigler and other economists who followed his lead was that all players in the regulatory regime — firms, bureaucrats, interest groups, and legislators — act as economic agents who have the interest and opportunity to advance strategic actions. Although public service may motivate players, Stigler pointed out that these are not the only incentives at work.

Final Thoughts…

Alfred Kahn on regulation

- Regulation is a very imperfect instrument for doing the world's work.
- It suffers from the evils of monopoly itself—the danger of exploitation, aggressively or by inertia, the absence of pervasive external restraints and stimuli to aggressive, efficient and innovative performance.
- Regulation itself tends inherently to be protective of monopoly, passive, negative, and unimaginative.



- The concentration by commissions on the rate base and rate of return has been far disproportionate to their importance compared with other dimensions of performance, has weakened incentive, and introduced distortions.

- Regulation is ill-equipped to treat the more important aspects of performance—efficiency, service innovation, risk taking, and probing the elasticity of demand. Herein lies the great attraction of competition: it supplies the direct spur and the market test of performance. . . .

- This suggests in a way that the imperfections of regulation are inherent defects not of the institutions but of the political process. . . . One's assessment of regulation, then, is closely determined by one's attitude toward American capitalism itself."

At one extreme

- There will be Marxist critics, who regard it, when they give any thought at all, as a logical development of monopoly capitalism itself—involving:
  - The accumulation of economic power in private hands,
  - Subject to nominal control by a government that is itself the servant of that same economic power
  - The vagueness of the governing statutes, the “political” character of the administrative commissions, the ever-present threat of legislative intervention if regulation becomes too effective in serving the public interest, the tendency of agencies to become the captive agents of their industries—all are symptoms of that fundamental concentration of power in private hands.

At another extreme

- Are the representatives of what the economist would readily recognize as “the Chicago school.”
- For these eighteenth century liberals, regulation is unnecessary as far as doing good is concerned but very effective when it comes to doing harm.
- It is unnecessary because private monopoly power is always limited in size, scope, and duration: the self-interest of even monopolists, the possibilities of competitive entry into all industries if only the government would permit it, the presence of actual competition even among the traditional public utilities all make regulation incapable of much improving matters and not worth its costs.
- But in its association with the use of government power to protect monopoly, especially by restricting entry, regulation is, according to this view, productive of much more harm than good.
- Monopoly is enduringly dangerous only when conferred and protected by government.

In between

- The great majority who regard the market economy much as they regard democracy—as a manifestly inefficient system that is better than any of the alternatives. . . .
- All competition is imperfect; the preferred remedy is to try to diminish the imperfections. . . .
- But to the extent that it is intolerably imperfect, the only acceptable alternative is regulation.
- And for the inescapable imperfections of regulation, **the only available remedy is to try to make it work better**.

Kahn's conclusion for regulators?
Try to make it work better…

Questions?

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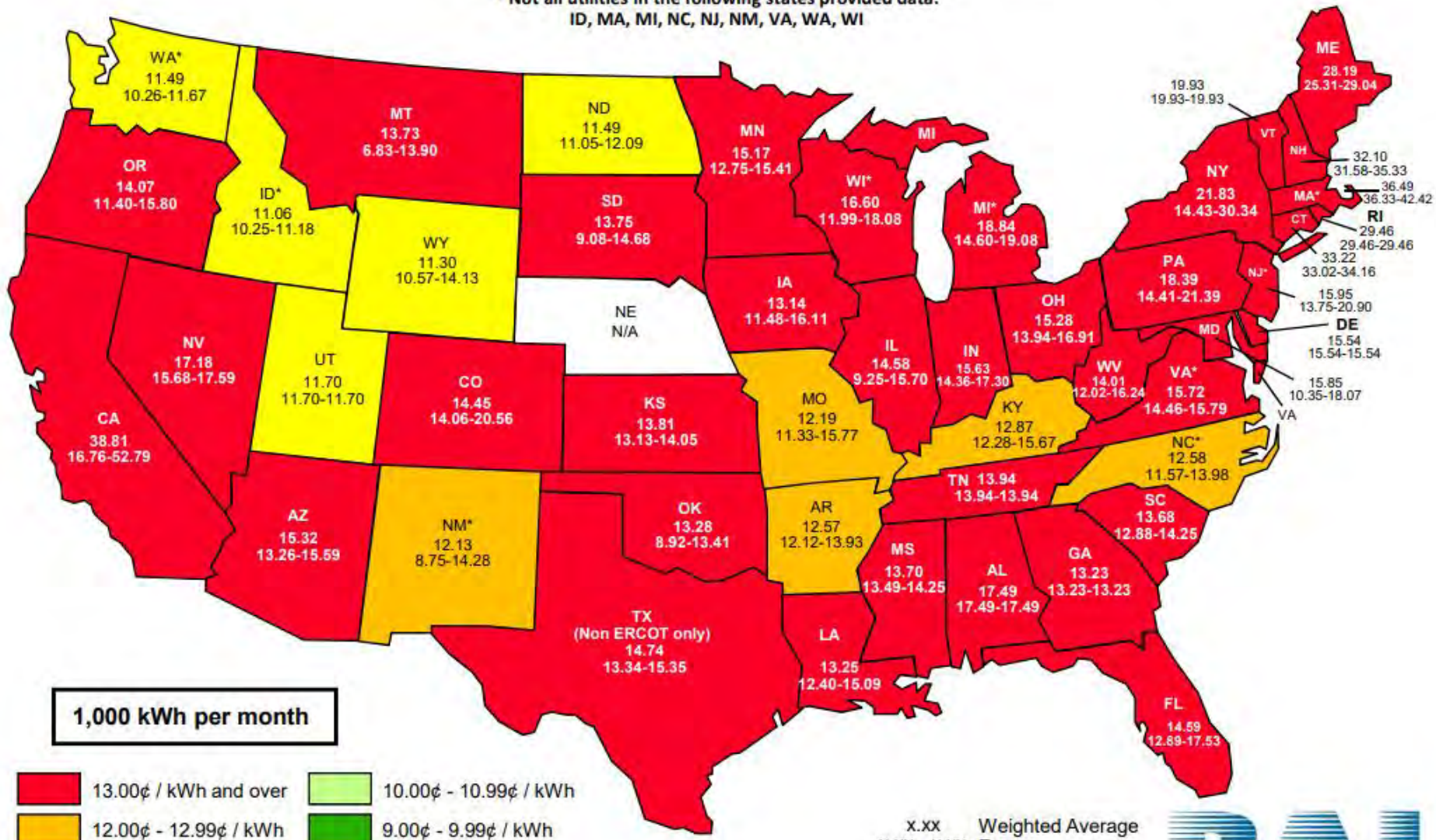
Year 2023 Residential Electric Rates (¢/kWh)
For Investor Owned Utilities

*** Not all utilities in the following states provided data:**
ID, MA, MI, NC, NJ, NM, VA, WA, WI



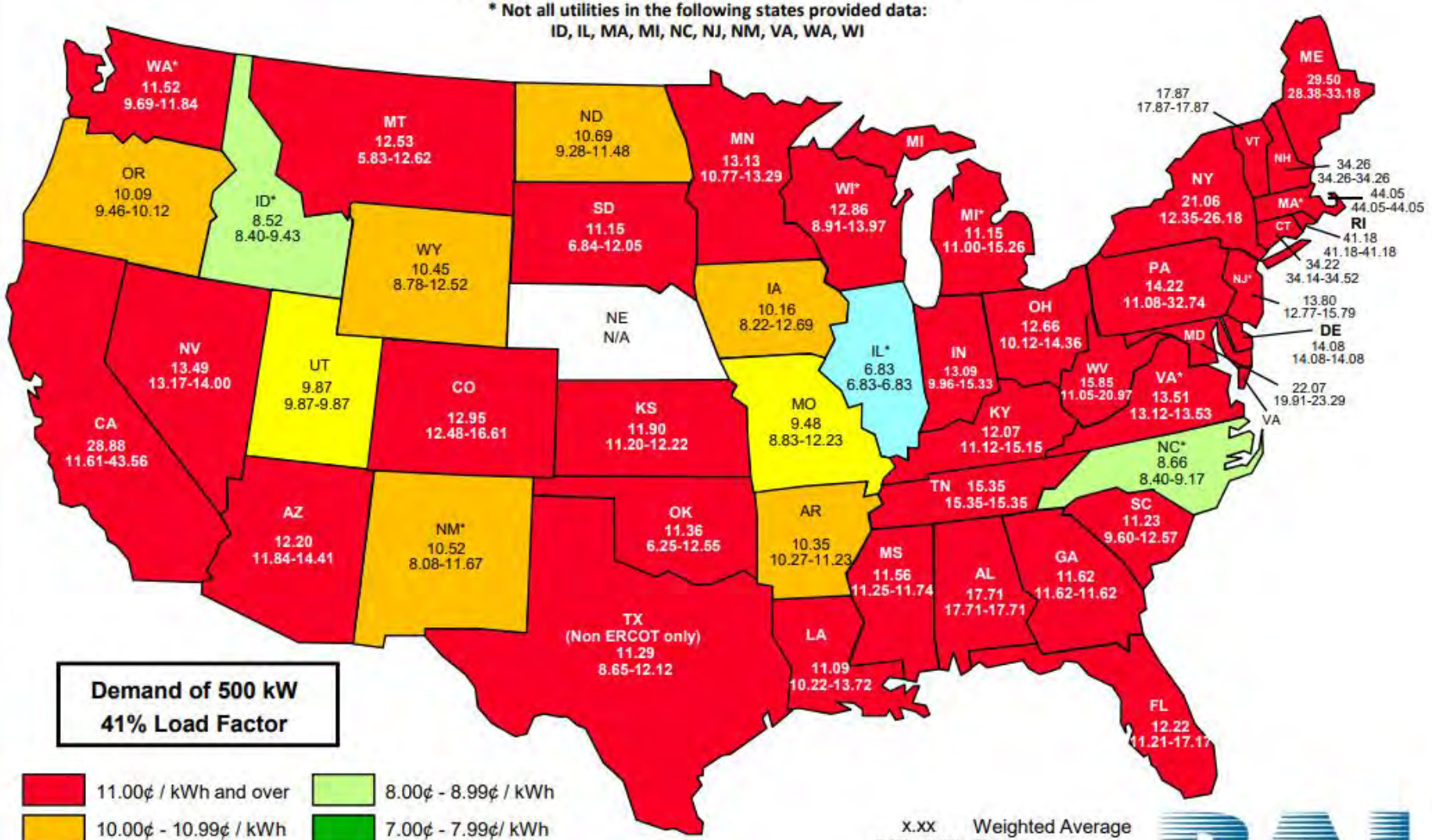
Source: Rates: Edison Electric Institute, Winter 2023 & Summer 2023 and supplemental calculations by BAI.
Weighting: Energy Information Administration/Electric Sales and Revenue

March, 2024

BRUBAKER & ASSOCIATES, INC.
Phone: (636) 898-6725
E-mail: bai@consultbai.com
Web page: www.consultbai.com

Year 2023 Commercial Electric Rates (¢/kWh)
For Investor Owned Utilities

*** Not all utilities in the following states provided data:**
ID, IL, MA, MI, NC, NJ, NM, VA, WA, WI



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Year 2023 Industrial Firm Power Rates (¢/kWh)
For Investor Owned Utilities

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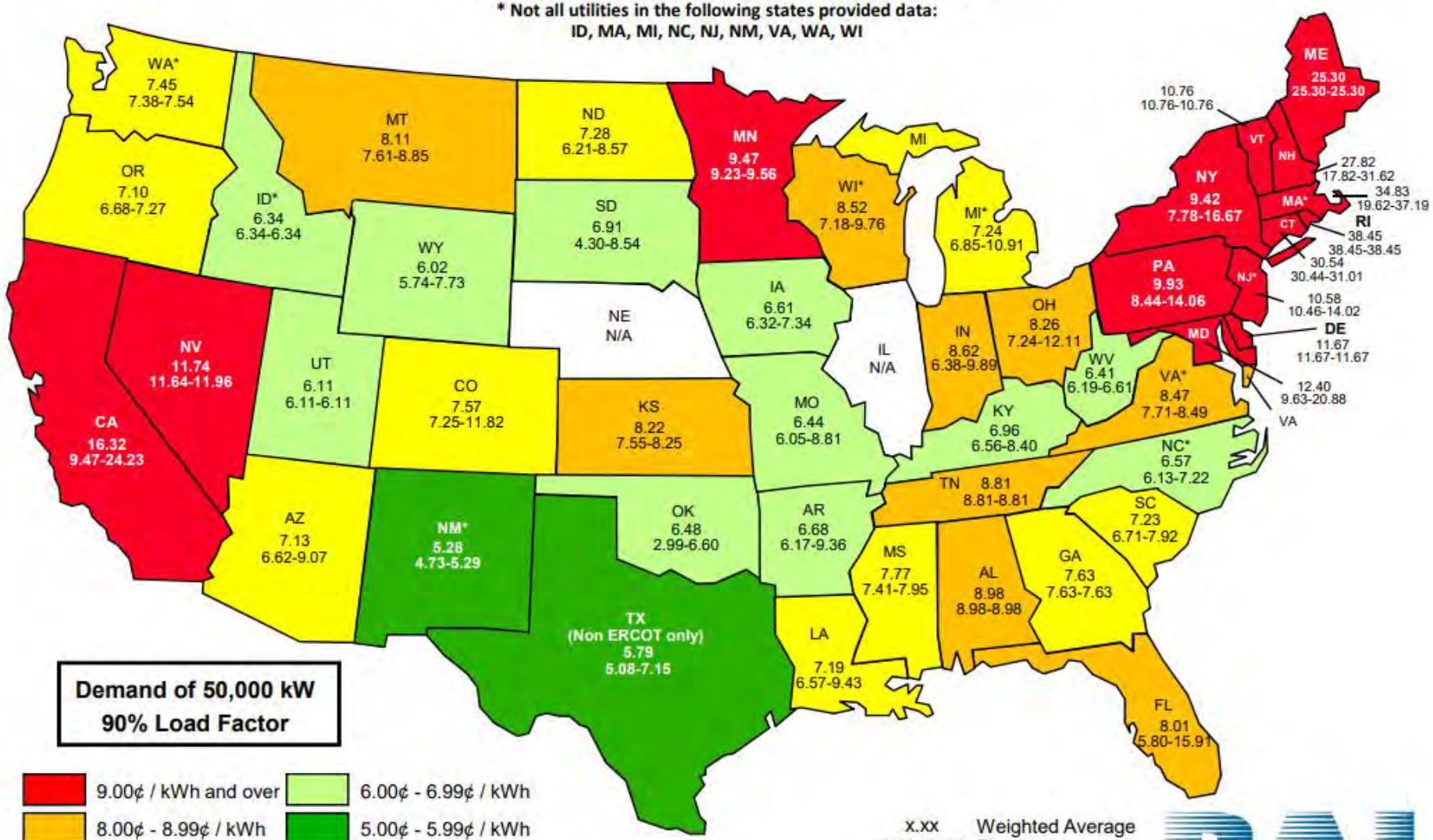

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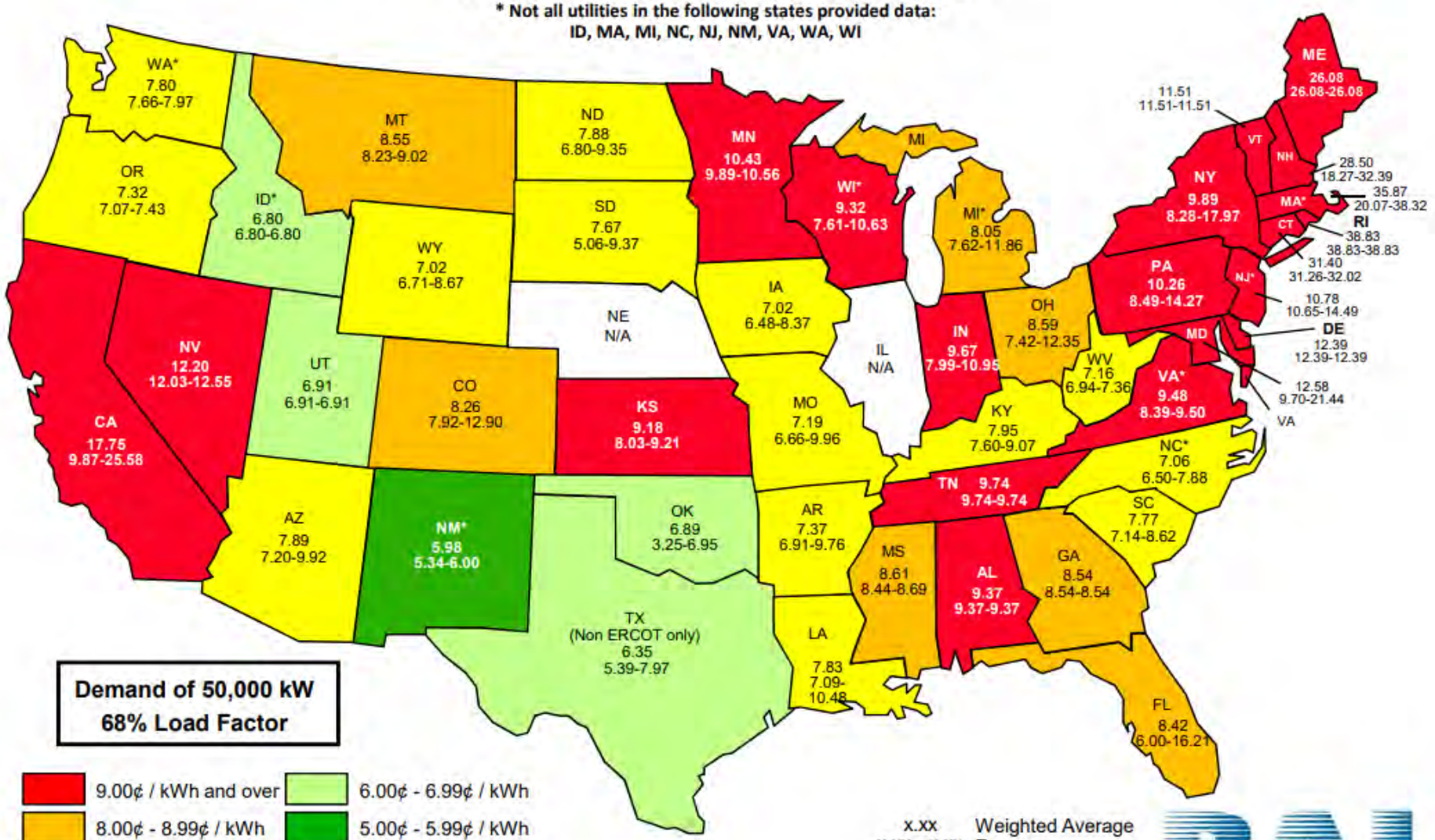

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