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Natural Gas Sector Breakout

Carl R. Peterson, Ph. D.

UIS

and

Concentric Energy Advisors, Inc.

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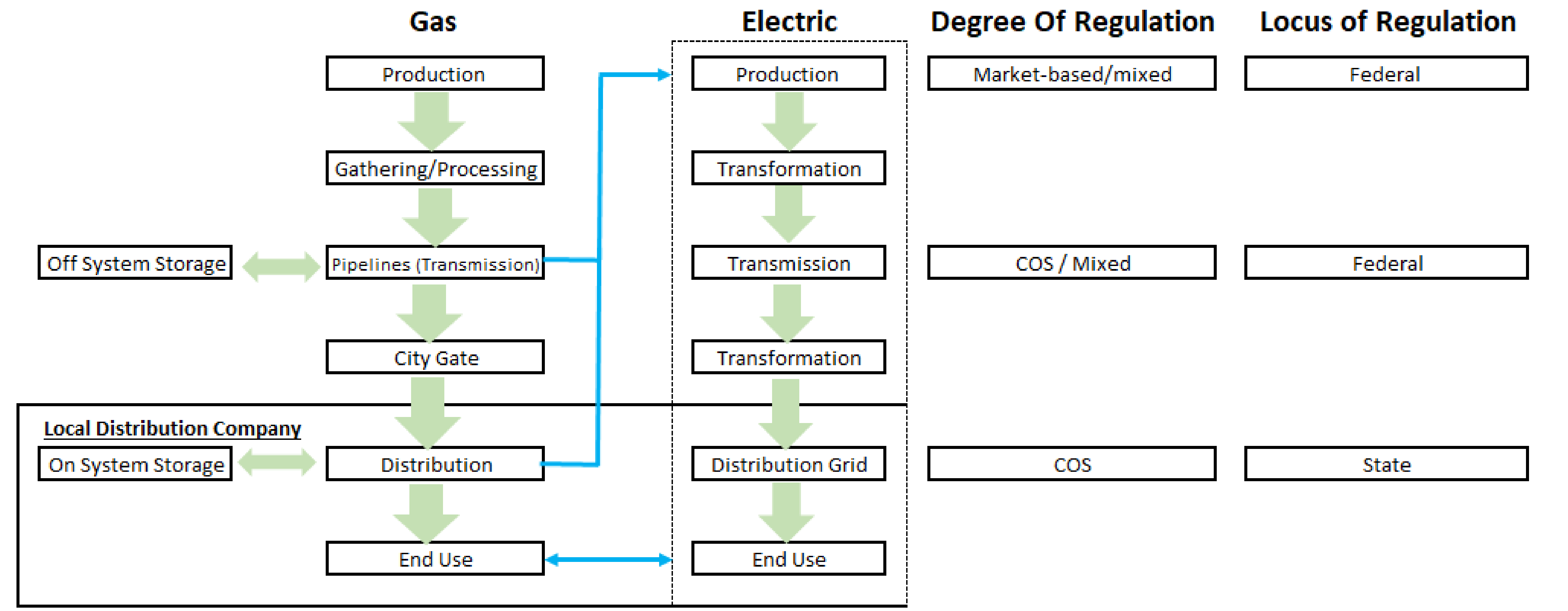
Annual Regulatory Studies Program
Institute for Public Utilities
Michigan State University
Delivered Remotely

Natural Gas Sector



Natural Gas Production

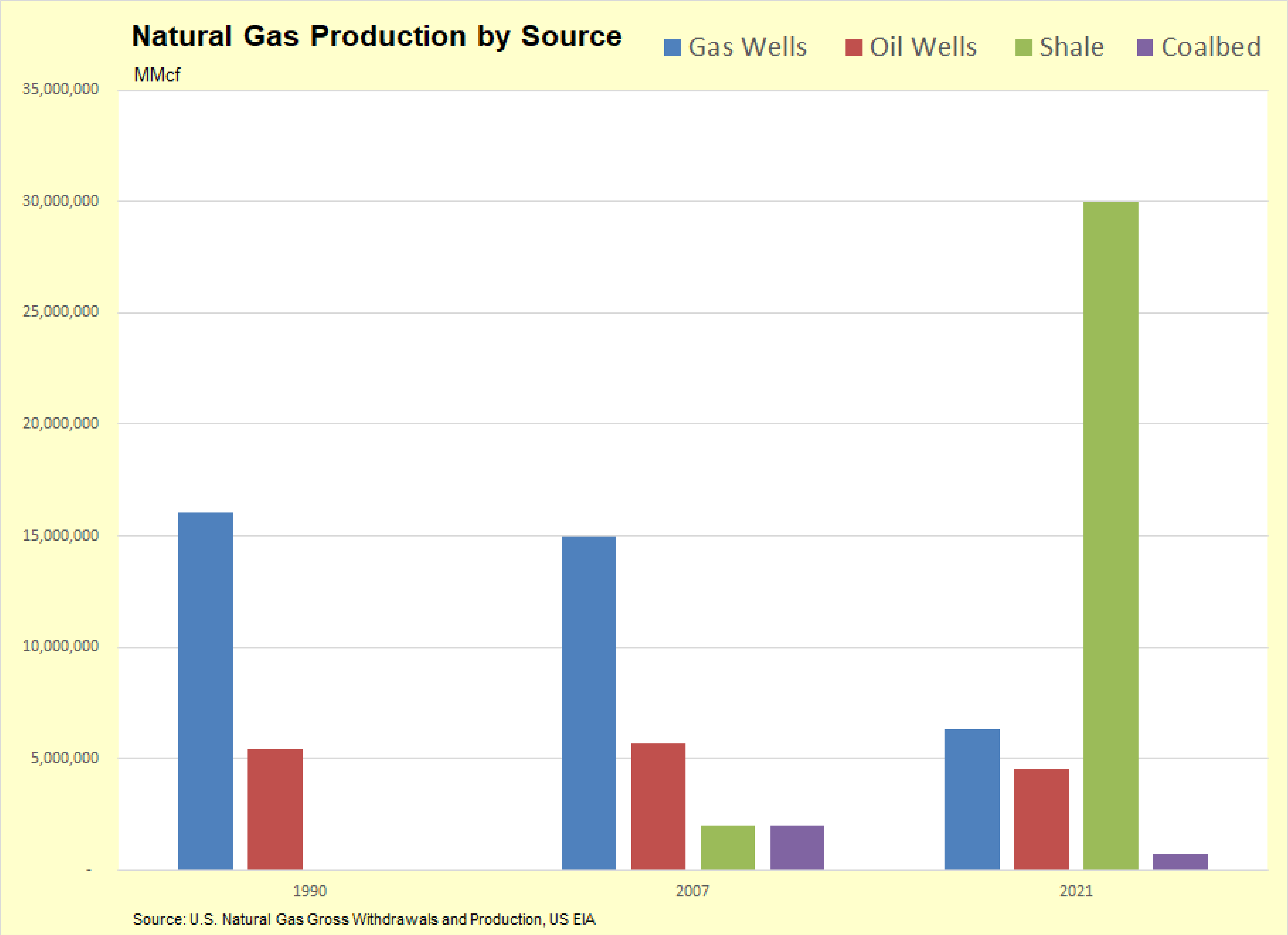
Natural Gas is a combustible combination of hydrocarbons, namely methane, but may contain levels of propane, ethane, butane etc.

Gas is extracted from wells. This point is called the "wellhead."

- Gas found with oil is called "associated-dissolved" meaning it is associated with or dissolved in the oil
- Non-associated gas is found without crude oil

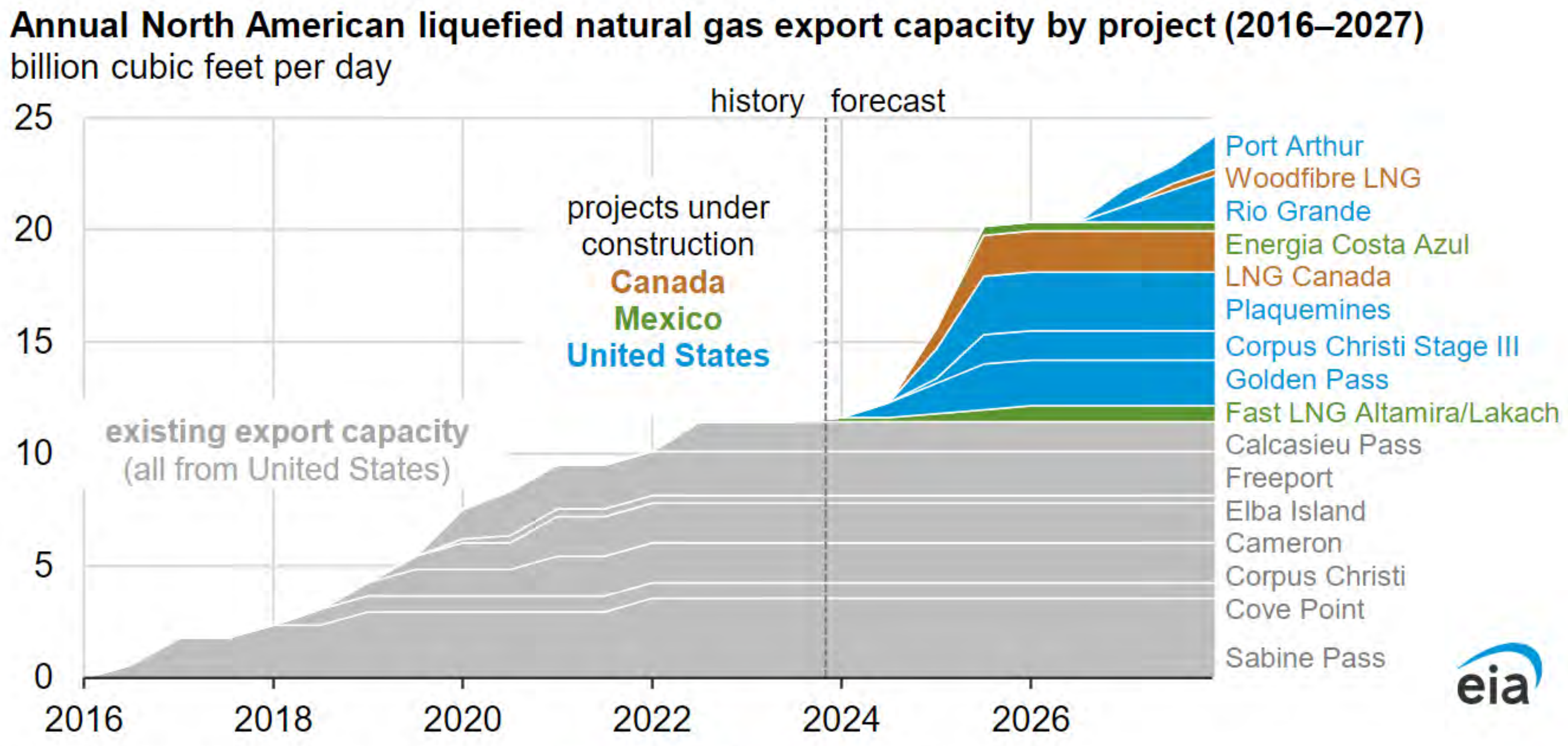
Gas is processed to extract by-products

- These are naturally occurring hydrocarbons that will become liquids at normal temperature and pressure. (Called "NGL" or natural gas liquids)
- Scrubbers are also used to remove large particles (e.g., sand)
- Exception is gas from coal beds or mines ("coalbed methane") which is methane and CO2



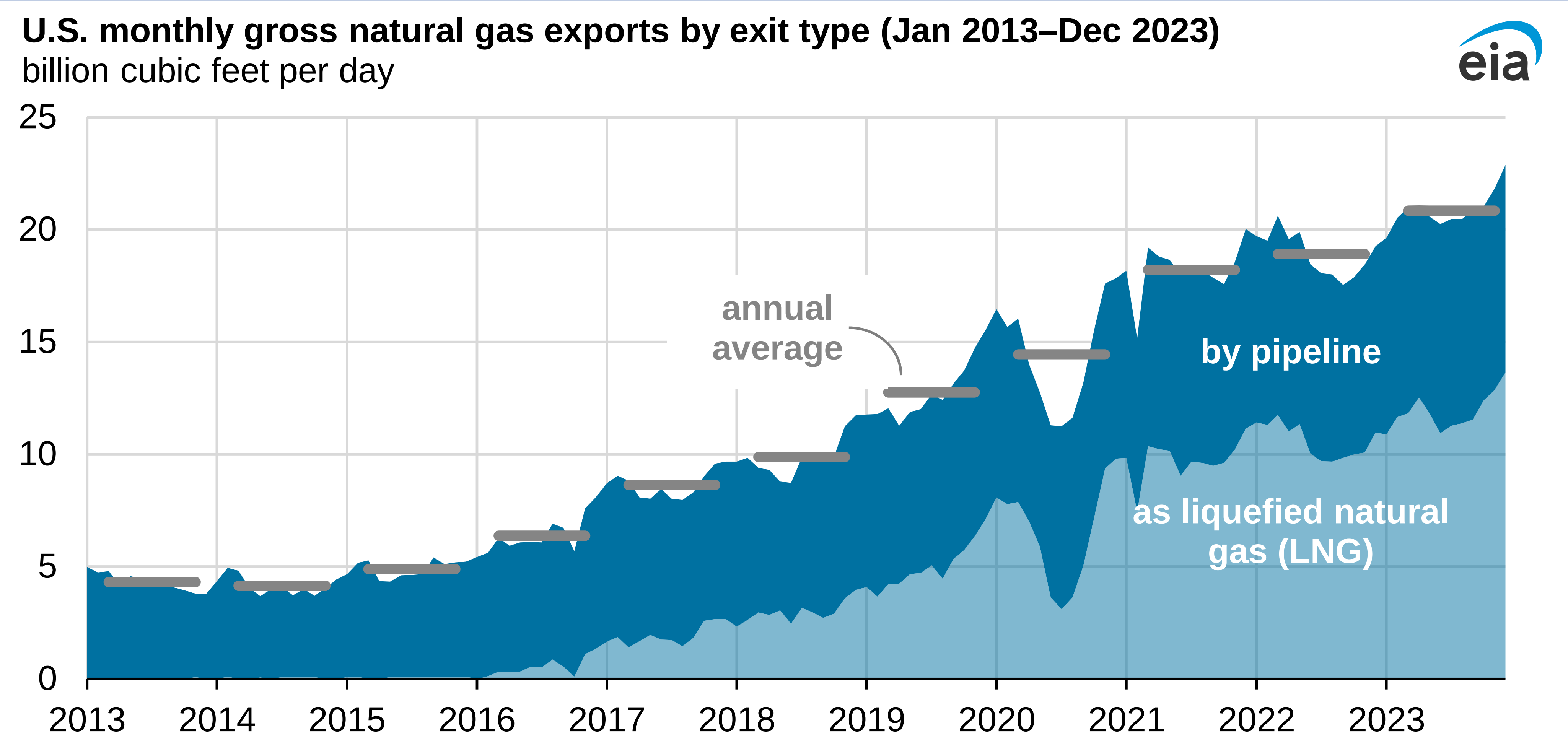
Natural Gas Production by Source
Gas Wells
Oil Wells
Shale
Coalbed
MMcf
35,000,000
30,000,000
25,000,000
20,000,000
15,000,000
10,000,000
5,000,000
-
1990
2007
2021
Source: U.S. Natural Gas Gross Withdrawals and Production, US EIA

Liquefied Natural Gas



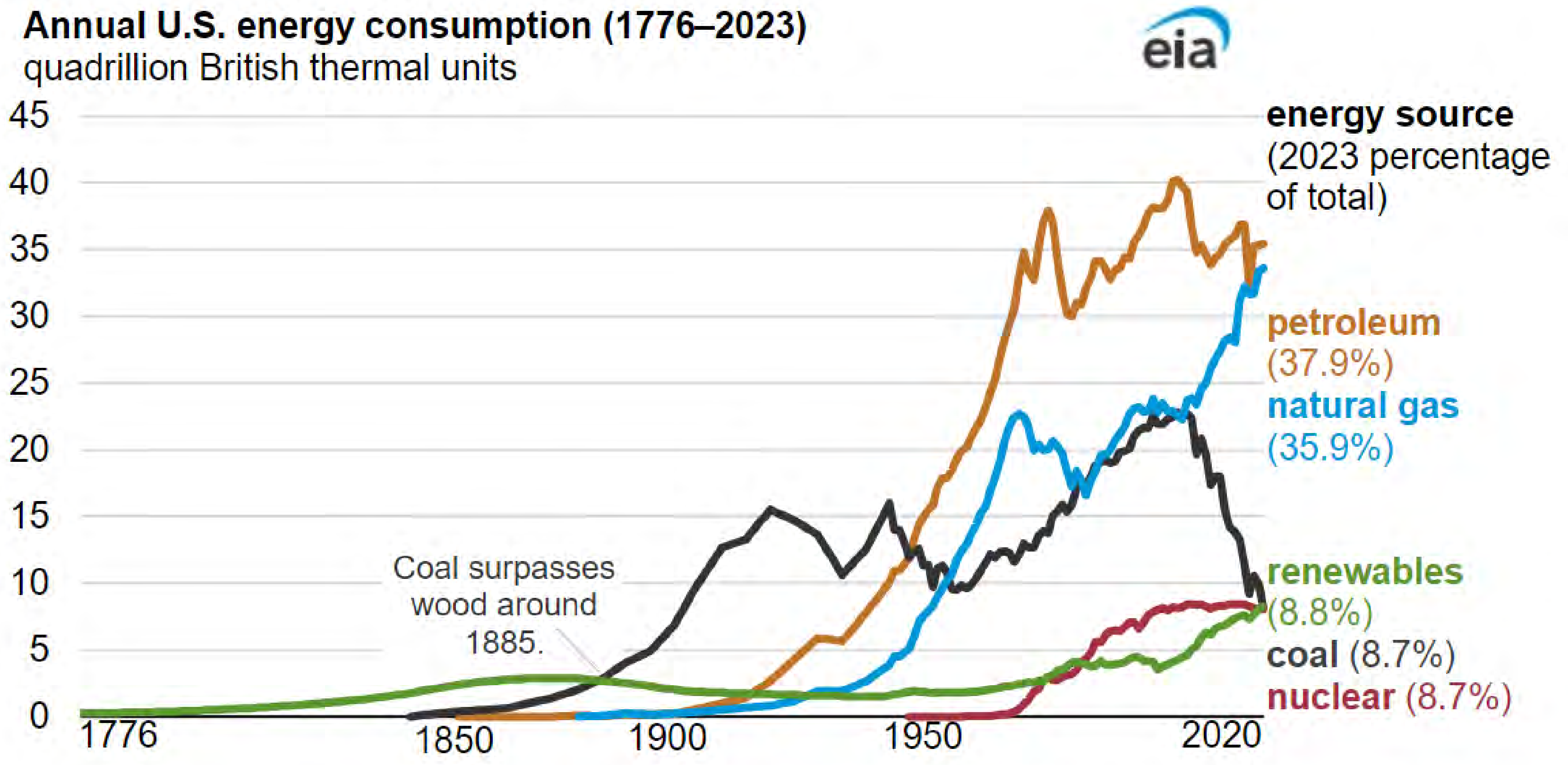
Data source: U.S. Energy Information Administration, *Liquefaction Capacity File*, and trade press
Note: LNG=liquefied natural gas. Export capacity shown is project's baseload capacity. Online dates of LNG export projects under construction are estimates based on trade press.

Exports



U.S. monthly gross natural gas exports by exit type (Jan 2013–Dec 2023)
billion cubic feet per day
eia
25
20
15
10
5
0
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
annual average
by pipeline
as liquefied natural gas (LNG)

Natural Gas Expanding as Fuel Choice



Data source: U.S. Energy Information Administration, *Monthly Energy Review*. Pre-1949 data based on *Energy in the American Economy, 1850–1975: Its History and Prospects* and U.S. Department of Agriculture Circular No. 641, *Fuel Wood Used in the United States 1630–1930*
Note: Data use captured energy approach to account for wind, hydro, solar, and geothermal.

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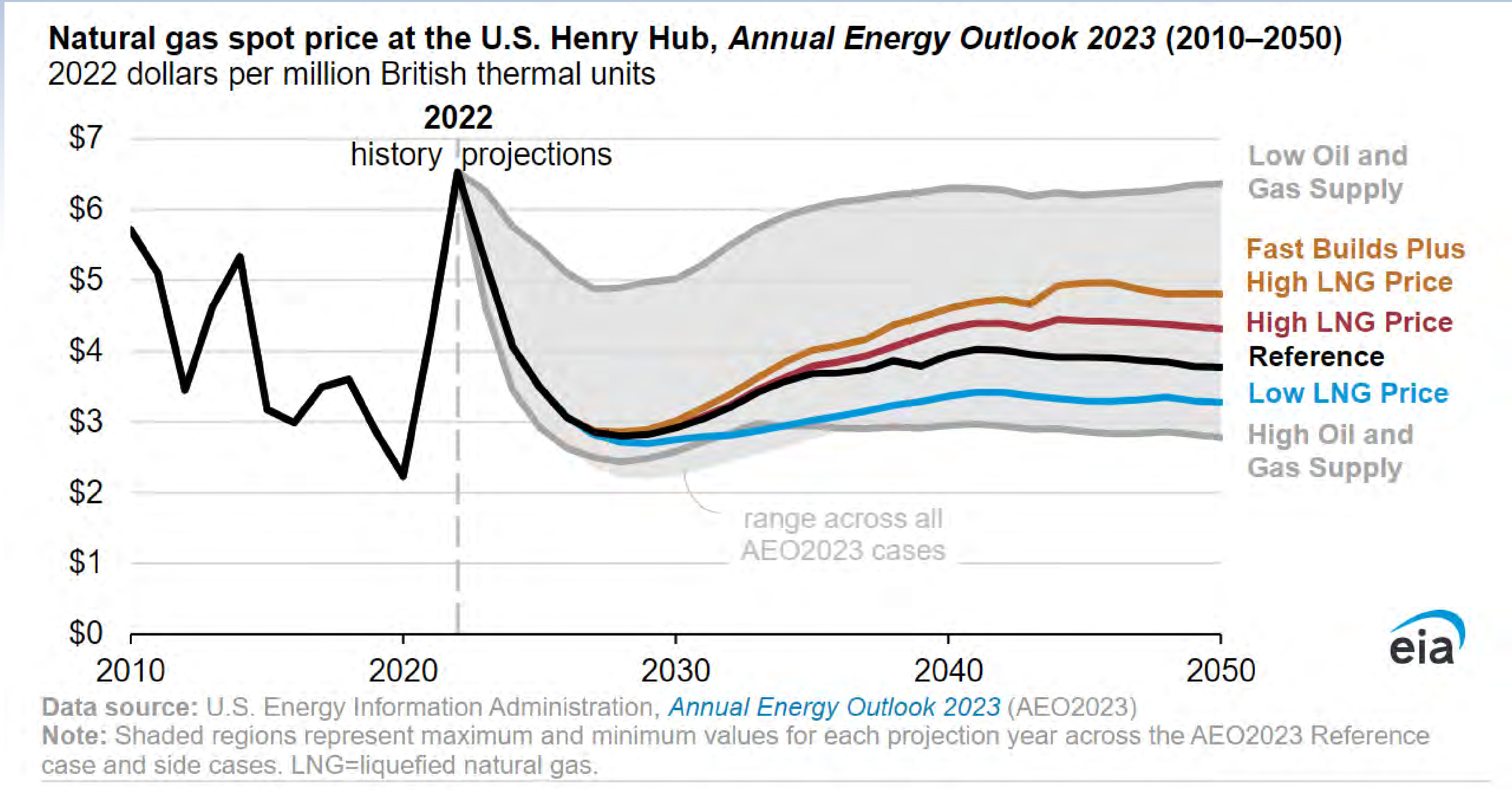
LNG Effect on Prices



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Current State of Industry

Pipelines (inter-state)

- Regulated under cost-of-service regulation by FERC (Section 4 NGA)
- Straight-fixed-variable (SFV) rate design
  - Contract demand
  - Fixed costs recovered through a capacity (i.e., rent) charge
- Distance or zoned rates
- Storage rates (when pipelines provide contract storage)
- Rates may be flexible
  - Discounting: rates can be charged between average variable cost (floor) and average total cost (ceiling)
  - Market-based rates: For services where no market power can be shown
  - Negotiated rates: no market power and a recourse rate

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Basics of Pipeline Cost of Service and Rate Design

First Step: Calculate the Pipeline total cost of service

RR = Return + O&M + A&G + DE + Non-Income Taxes + Income Taxes - Revenue Credits

Revenue credits might come from processing salable liquids or excessive penalty revenues

Second Step: Functionalize Cost of Service

Two basic functions: Storage and Transmission

O&M and Capital Costs Assigned Directly to Function

A&G allocated to functions (e.g., K-N Method based on labor and plant ratios, A&G costs are classified as labor or plant and then allocated to functions based on direct labor and gross plant)

Step Three: Classify Costs

Fixed and Variable (Demand and Commodity)

Historically Demand was not classified as totally a fixed cost; in 1992 under Order 636 FERC moved toward the SFV rate design and classified all fixed costs as demand

Step Four: Allocate Costs

If pipeline has zones, allocated the costs to different zones based on capacity-miles (delivered amount to each zone)

Allocate to different services (non-notice, short-term firm, interruptible, etc.)

Step Five: Design Rates

Firm Service: Reservation charge on contract demand and usage charge

Interruptible (non-firm) service

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Pipeline Rate Example

Suppose total demand cost of service = $20,000 and commodity is $125

- Total Demand = 2,500 Dth
- Demand charge = $20,000/2,500 = $8/Dth (firm rate)
- Commodity Charge = $125/2500 = 0.05 cents /Dth

Example Customer:

- Customer reserves 10,000 Dth/day but only uses 100,000 in the month
- Bill = 10,000*8 = $80,000 and 100,000 * 0.05 = $5,000
- Average price = $85,000/100,000 = $0.85/Dth
- Why so expensive?
  - Bad load factor (100,000/300,000 = 33%)
  - Bad nomination practices (contract demand is too high)

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What about interruptible rates?

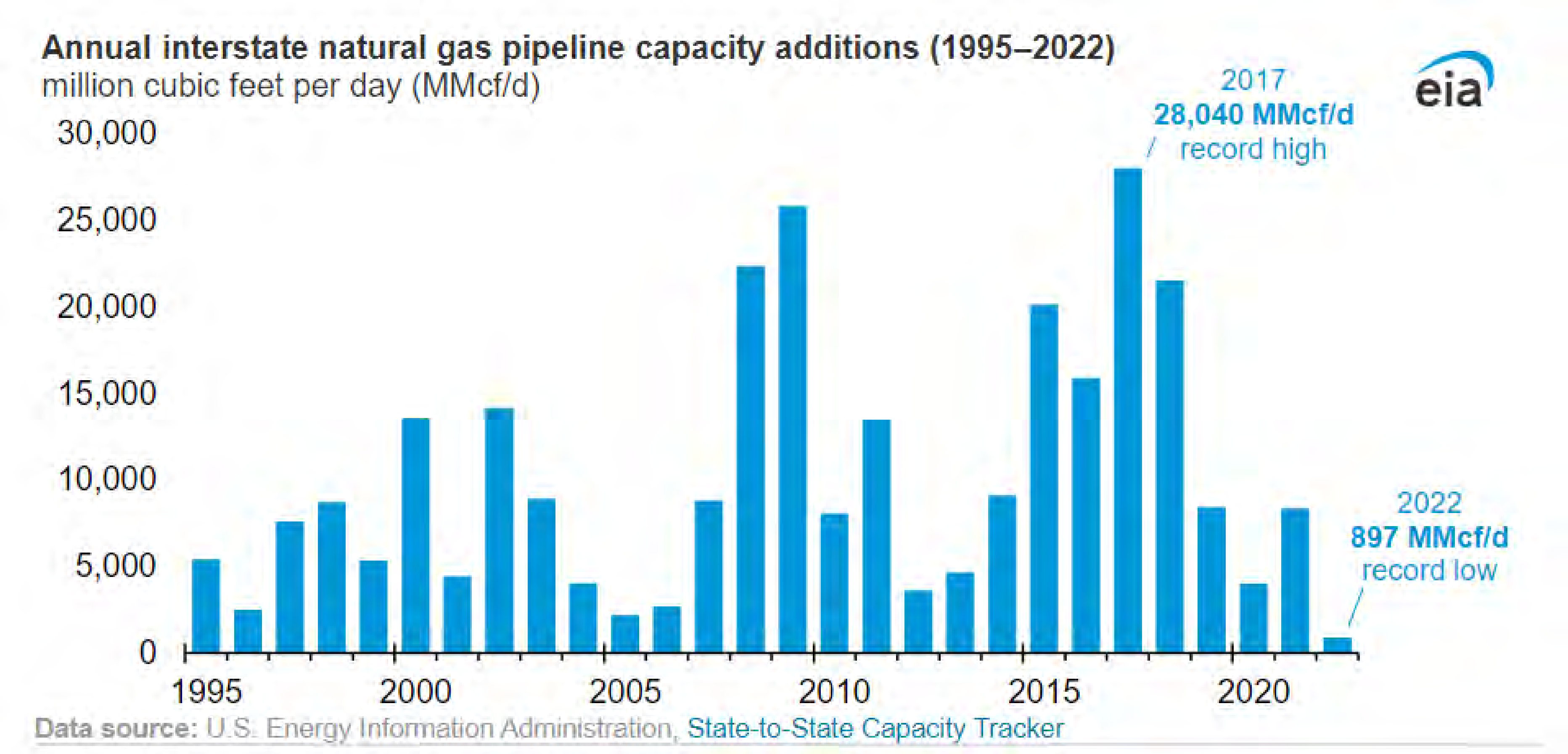
Price at variable cost? What if it is zero?

Price at average cost? Likely too high for an inferior service

Price at market? If market alternatives exist this is good solution

- If not, 100 percent load factor rate
  - Suppose the total capacity of the pipe is 3,500
  - Interruptible rate = $20,000/3,500 = $5.71/Dth

Pipeline Expansion



Large increase in 2024 most co-located with export demand

Storage

What are storage fields?

- **Salt domes (31)**
- **Aquifers (43)**
- **Depleted gas/oil fields (326)**

What is it used for?

- Meet the regulatory obligation to ensure supply reliability
- Avoid imbalance penalties
- Ensure liquidity at market centers

Storage is a substitute for direct gas supplies from production

Shale production is substituting for storage

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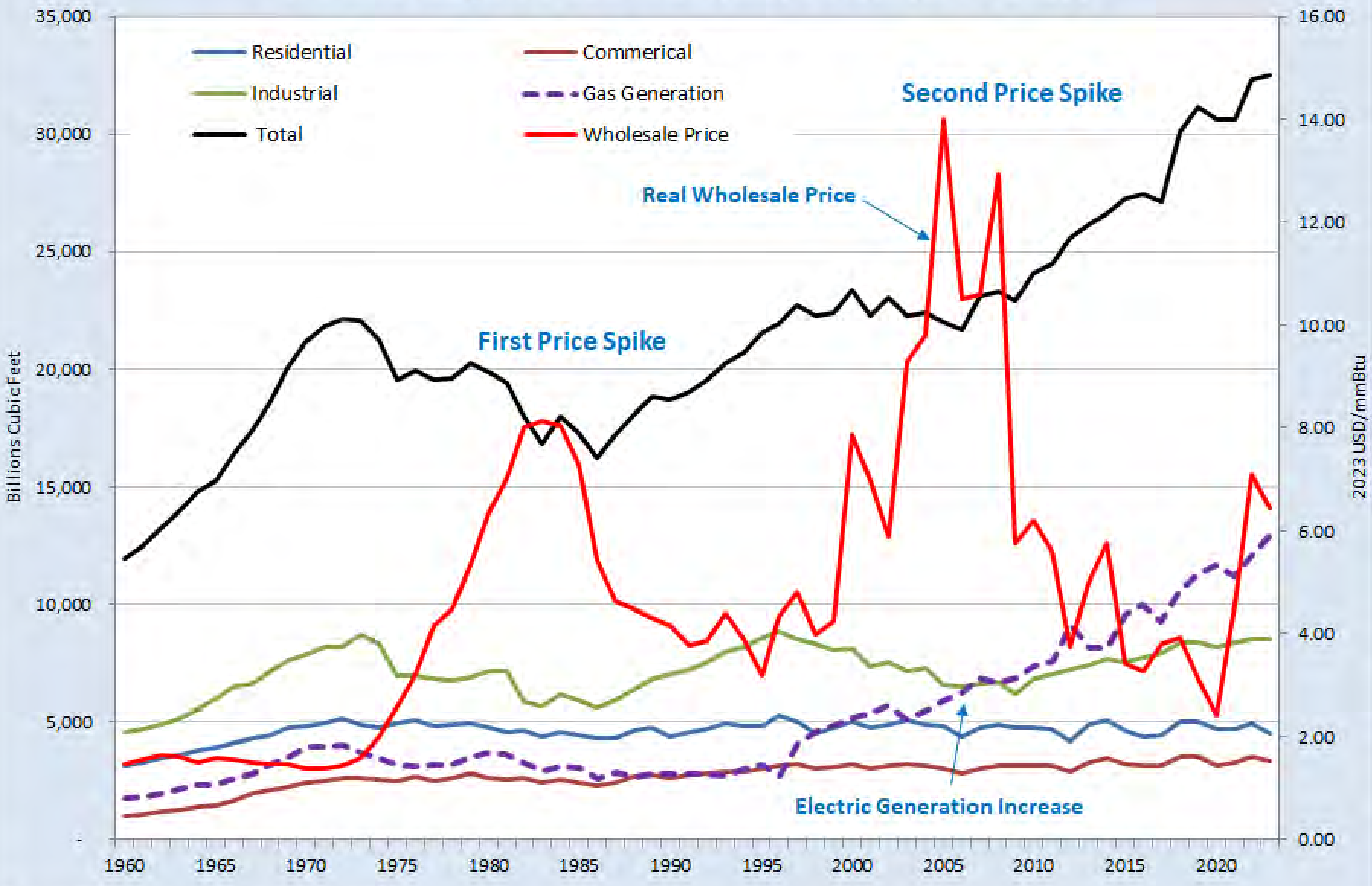
Gas Consumption and Wholesale Prices (1960-2023)



Source: EIA Historical Natural Gas Statistics

Local Distribution

What are the major issues facing the LDC and its regulators?

Cost of Service

Interclass Revenue Allocation

Rate Design

Future of Gas

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What is Cost of Service and Rate Design?

Cost of service is an analytical approach to determining who should pay for the total revenue requirement

Judgment is a major part of cost of service and reasonable people do disagree

Cost of service supports rate design, but rate design is often as much related to the objectives of designing rates

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Capital Expenses

OPEX +Interest + Taxes

Return of and on Capital

→ **Revenue Requirement**

↓

Operational Data

Economic Analysis

Judgment

→ **Cost of Service**

↓

Revenue Recovery

Price Signals

Efficiency

Equity

→ **Rate Design Objectives**

↓

Rate Shock

Social Concerns

Policy Concerns

→ **Other Factors**

↓

Final Prices

Creating Rates

Capital Expenses

OPEX +Interest + Taxes

Return of and on Capital

Revenue Requirement

By Function

By Cost Driver

By Customer Class

Revenue Requirement

Operational Data

Economic Analysis

Judgment

Cost of Service

Unbundled Costs

What is the Output?

Class Cost Responsibly

Class Profitability

Class Cost Study

Rates

Residential

Commercial

Industrial

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Objectives for Rates*

Low-income and medical baseline customers should have access to enough electricity to ensure basic needs (such as health and comfort) are met at an affordable cost;

Rates should be based on marginal cost;

Rates should be based on cost-causation principles;

Rates should encourage conservation and energy efficiency;

Rates should encourage reduction of both coincident and non-coincident peak demand;

Rates should be stable and understandable and provide customer choice;

Rates should generally avoid cross-subsidies, unless the cross-subsidies appropriately support explicit state policy goals;

Incentives should be explicit and transparent;

Rates should encourage economically efficient decision-making;

Transitions to new rate structures should emphasize customer education and outreach that enhances customer understanding and acceptance of new rates, and minimizes and appropriately considers the bill impacts associated with such transitions.

*ALJ Ruling in CPUC R.12-06-013 "Order Instituting Rulemaking on the Commission's Own Motion to Conduct a Comprehensive Examination of Investor Owned Electric Utilities' Residential Rate Structures, the Transition to Time Varying and Dynamic Rates, and Other Statutory Obligations."

Objectives often loaded with jargon that needs definition

What is marginal cost?

What is cost causation?

What does “encourage” mean and how is that different from “incentive?”

What is a cross-subsidy?

What are stable rates? What are understandable rates?

What is economically efficient decision-making?

What is a bill impact and how do we minimize bill impacts?

Cost of service can answer **some** of these questions

Retail Price Jargon

Base rates: rates that recover the costs of investment and operations of the network

- Generally, set in a rate case using the cost-of-service principles Some costs may be taken out and addressed on a single-issue basis (e.g., pensions, bad debt, lost revenues, etc.)
- Utility earns a margin (i.e., profit) from these rates

Purchased Gas Adjustment: rates that recover the cost of purchasing gas for customers that buy from the utility

- Generally, set on an annual or semi-annual basis based on the cost of procuring the commodity (and transport to deliver commodity)
- Revenues from these prices are reconciled to actual costs generally on an annual basis
- Utility does not earn a margin on these rates

Billing determinants: Factors used to compute a customer's bill (e.g., number of customers, usages, demand, power factor, etc.)

Typical Tariffs

	Residential	Commercial	Industrial
Customer Charge	$25/ month	$ 20.80 (<1,000 cfh) $72.80 (1-10k cfh) $132.60 (> 10k cfh)	$2678/ month
Demand Charge			$ 1.53 (<10,000 peak) 12.36 ¢ (>10,000 peak)
Volumetric	4.85 ¢/therm or 0 -50 therms: 28.5 ¢ >50 therms: 15.5 ¢	0 -100 therms: 14.72 ¢ 100-4900 therms: 12.36 ¢ > 4900 therms 7.62 ¢	0.52 ¢/therm
Definition	Single Meter 1 or 2 dwelling (residential) units	Any general use less than 40,000 therms	Any general use over than 40,000 therms

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Factors Affecting Rate Design Choices

Economic

- Cost of service
- Value of service
- Competitor prices
- Price differences and discrimination
- Availability of gas supply and capacity
- Return and revenue stability

Regulatory Factors

- Precedent
- Intervenor interests

Usage Patterns

- Changes in peak demand
- Changes in overall throughput

Historical Factors

- Rate perspective
- Rate continuity

Social and Political Factors

- Customer reaction and acceptance
- Public relations aspects
- Economic conditions of service territory
- Social obligations to particular customer groups
- Political attention and involvement

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Steps in Cost of Service

- **Obtain test year utility revenue requirement**
  - Other revenues (e.g., off-system sales, Hub sales, etc.)
  - Jurisdictional revenues/costs
- **Obtain load and market characteristics of customers base**
- **Determine customer classes**
- **Billing determinants**
  - Weather normalization may be a big issue here
- **Allocation of costs to cost-causers**
- **Market characteristics (e.g., bypass opportunities)**

Costs Part 1 of 2

Time Frame

Short-run: One input, normally capital, is fixed

Fixed Cost: Cost of that fixed input

Variable Cost: Cost of all other inputs as output changes

Long-run: All inputs are variable, there are no fixed costs in the long-run

Revenue Requirement: Total cost allowed in rates

Joint/Common:

Common costs result from usage of a common asset

Industrial and Residential customers using capacity simultaneously

In principle could be allocated based on opportunity cost

Joint costs result in joint production:

Peak and off-peak capacity

In principle cannot be allocated

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Costs Part 2 of 2

Average Cost: Total economic cost divided by output

Marginal Cost: Measure of change in total economic cost as output changes

- Economic costs supporting optimal pricing
- Time frame: Short-run v. Long-run

Residual Costs: Difference between LRMC and Revenue Requirement

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Embedded Cost Studies

Step 1: Functionalize (production, distribution, transmission etc.)

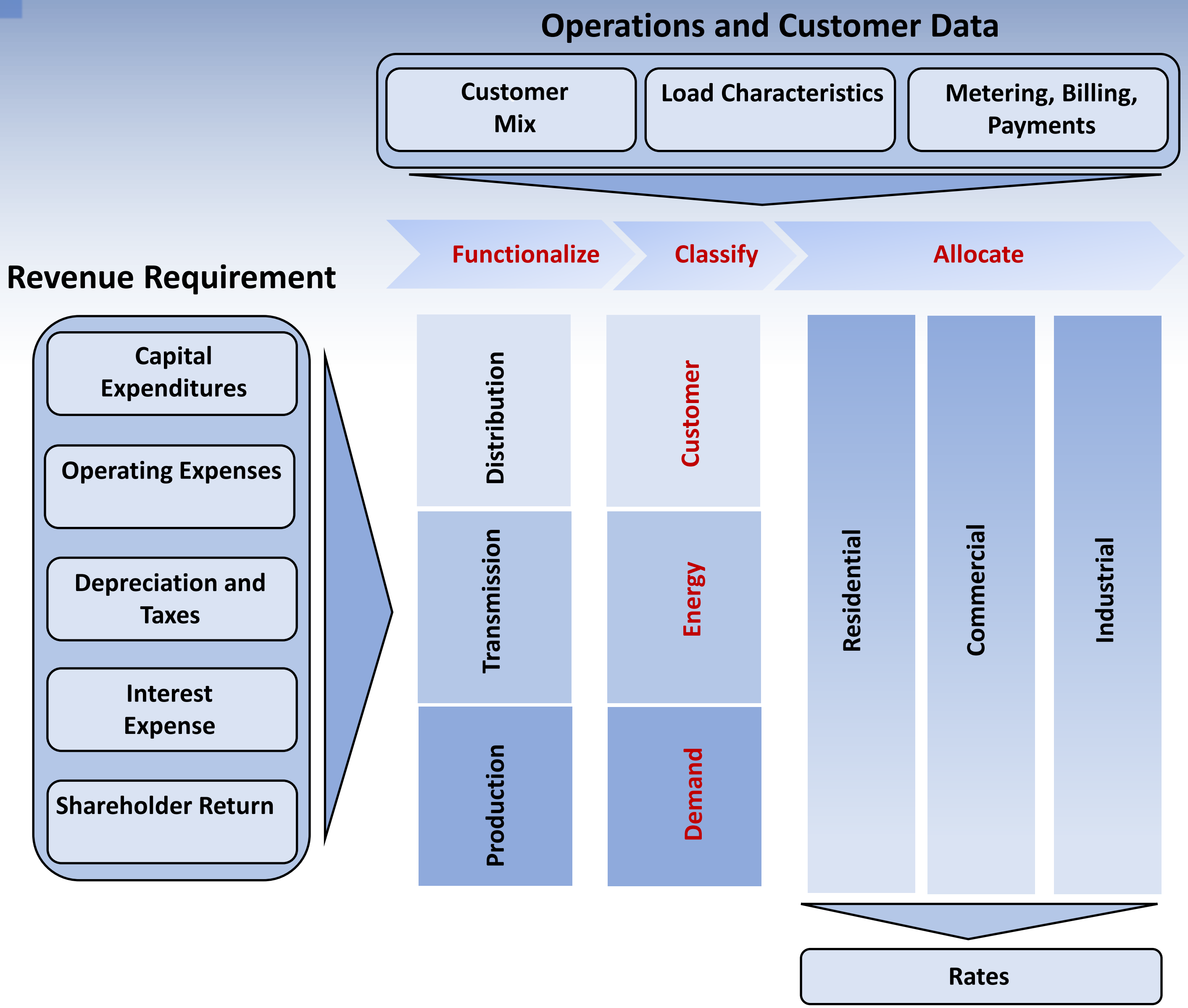
- Functionalization is generally an accounting exercise (i.e., use USOA)

Step 2: Classification (demand-related, volume-related, customer-related, etc.)

Step 3: Allocation

- Direct assignment
- Allocator (demand, energy, customers, etc.)

Overview of Cost Allocation Process



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Classification of Costs: Controversy over Gas Mains

- **What are gas distribution mains used for?**
  - **Meeting peak demand?**
    - Historic and future planning parameters
    - Mains are sized to meet the highest peak demand on the peak day
  - **Meeting average demand?**
    - What evidence exists concerning the reason for investment (e.g., maintenance and replacement of existing mains)
  - **Hooking up customers?**
    - How does investment cost change with number of customers?
- **If some costs are customer-related, how much?**
  - Minimum system study
  - Zero-intercept

Allocation of Costs: Controversy over Gas Mains

Recall questions about classification

Why are we allocating? Joint and common costs

Should mains be allocated on peak day (design or actual);
combination of peak days (3-highest); what about average demand?

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Demand Allocators

Coincident Peak (CP): Measure of class contribution to system peak

- Logic: System planned to meet peak; costs should be allocated based on customer class contribution to peak demand

Non-coincident Peak (NCP): measure of maximum demand of each class regardless of time of demand

- Logic: Utility must meet customer peak demand
- Unaffected by timing of system peak

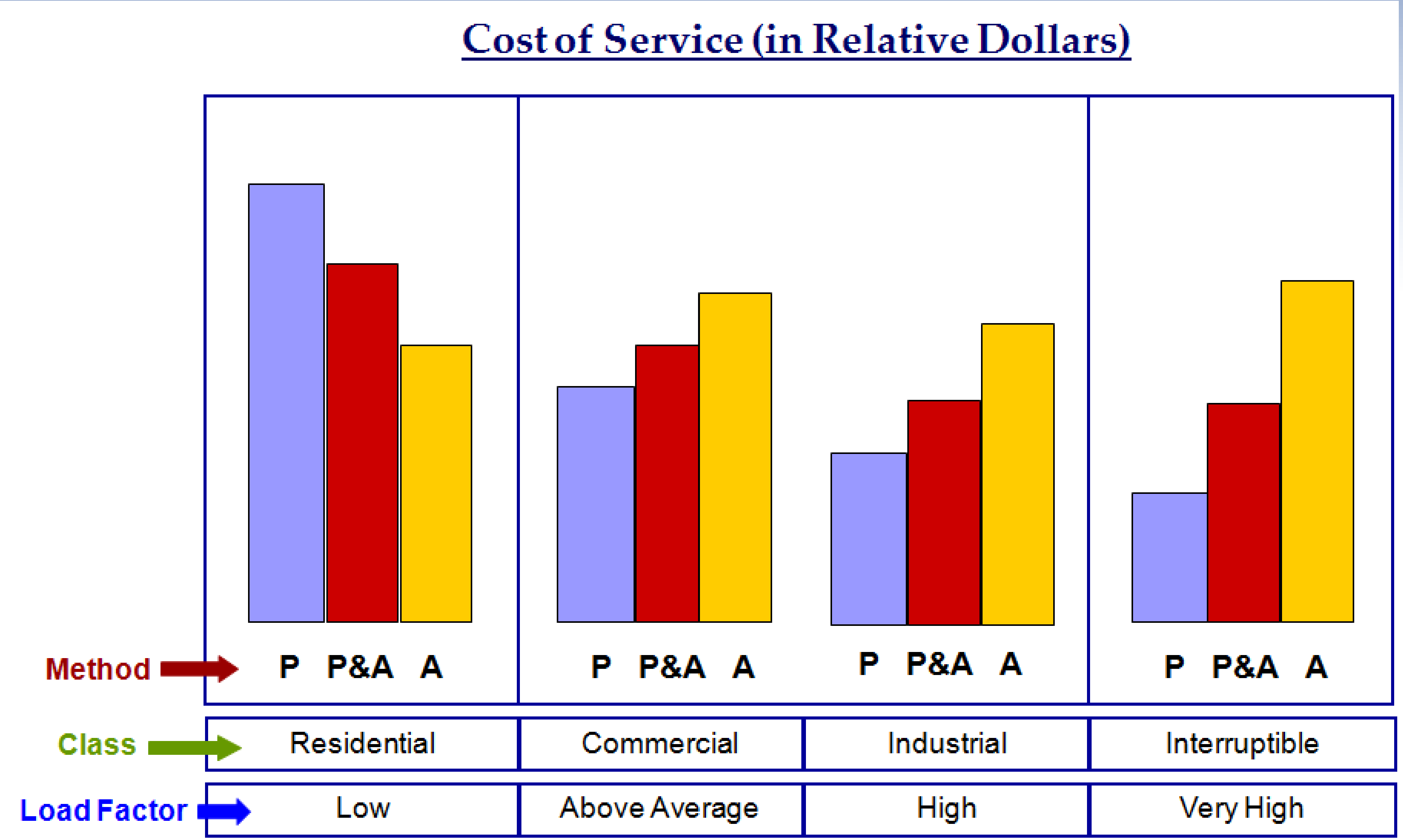
Average and Excess (AE): = LF*AVG DEM + (1-LF)* (Class NCP – AVG DEM)

- Logic: Low load factor customers do contribute to load diversity reducing demand costs
- System peak demand not generally important for this allocator

Average and Peak (A&P): weight *AVG DEM + (1-weight)* (CP)

- Logic: utility assets are uses year-round, not just at peak
- Not all assets deployed to meet peak (e.g., transmission assets may be used to find new supply which is used year-round)
- Weighting could be LF or some other number e.g., 50/50 (called the Seaboard Method)

What is the difference?



Source: R. Feingold "Traditional and Unbundled LDC Rate Design" AGA Rates School, August 2010, Center for Business and Regulation, Chicago, IL

Allocation Principles

Herz (1956)	NARUC (1955)	Brattle (2019)
All utility customers should contribute to capacity costs	The method should establish a minimum demand-cost allocation to off-peak customers.	Customers who benefit from the use of the system should also bear some responsibility for the costs of utilizing the system
The longer the period of time that a particular service preempts the use of capacity the greater should be the amount of capacity costs allocated to that service.	The method should be judged on its recognition of (a) demand (b) usage and (c) time of use	Reflect cost causation as much as possible; i.e., based upon the actual activity that drives a particular cost and on rate classes' share of that activity;
The allocation of capacity cost should change gradually with changes in the pattern of sales.	The method should result in relatively stable cost assignment which would not change radically with a shift in loads.	Produce fairly stable results on a year-to-year basis
Any service which makes exclusive use of a portion of capacity should bear all the demand costs assignable to that portion of capacity. A 100 percent load factor service should be allocated the entire demand costs but no more.	The method should recognize the characteristic of the various loads	Reflect the actual planning and operating characteristics of the utility's system;
Service that can be restricted by the utility should be allocated less in demand costs	The method should permit allocation to a load which is completely under utility control, such as off peak water heating	Recognize customer class characteristics such as demands, peak period consumption, number of customers and directly assignable costs
The capacity costs allocated to one class of service should not be affect by the way in which the remaining capacity costs are allocated to other classes.	The method should be based on some basic philosophy The method should require a minimum of measurements before and after allocation The method should not be dependent upon judgment introduced in the allocation process	
More demand costs should be allocated to a unit of capacity preempted during a peak period than to one preempted in off-peak	The method should permit an estimate of the capacity cost that could be assigned to prospective loads	

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Points to Remember

ECOSS are not particularly accurate –should be used as a guide

Problems do arise when prices diverge too far from cost of service

How much effort should you put into a cost study?

Utilities have a tremendous amount of unique information – ask for it.

Some will argue to use sensitivity analysis on cost studies

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What to Look for In Cost Study

The Gas Company
Schedule 1.00
Summary of Embedded Cost of Service Study

Line No.		SC-1 Residential	SC-2 Commercial	SC-3 Large General Service	SC-4 Contract Service	SYSTEM TOTAL
1	**Current Operating Revenues**	$ 47,923,277	$ 13,814,922	$ 19,608,070	$ 933,863	$ 82,280,132
2	**Current Other Revenue**	$ (1,070,311)	$ (508,614)	$ (468,361)	$ (9,963)	$ (2,057,249)
3	**CURRENT TOTAL REVENUE**	**$ 46,852,966**	**$ 13,306,308**	**$ 19,139,709**	**$ 923,900**	**$ 80,222,883**
4	OPERATING EXPENSES					
5	Operation and Maintenance	$ 6,407,763	$ 2,680,464	$ 2,431,420	$ 60,034	$ 11,579,682
6	Depreciation Expense	$ 10,840,711	$ 5,129,462	$ 4,734,131	$ 126,629	$ 20,830,933
7	Administrative and General and Cust Exp	$ 21,276,701	$ 3,753,786	$ 192,689	$ 3,003	$ 25,226,179
8	Taxes Other Than Income	$ 2,171,848	$ 966,794	$ 898,587	$ 26,910	$ 4,064,140
9	Income Taxes	$ 6,748,191	$ 3,092,328	$ 3,044,852	$ 86,101	$ 12,971,472
10	**TOTAL OPERATING EXPENSES**	**$ 47,445,215**	**$ 15,622,834**	**$ 11,301,679**	**$ 302,678**	**$ 74,672,406**
11	**CURRENT NET OPERATING INCOME**	**$ (592,248)**	**$ (2,316,526)**	**$ 7,838,030**	**$ 621,221**	**$ 5,550,477**
12	RATE BASE					
13	Net Plant in Service	140,664,455	64,705,341	64,528,571	1,729,747	271,628,114
14	***Rate Base Additions***					
15	Cash Working Capital	(618,943)	(146,043)	(68,008)	(1,678)	(834,672)
16	Materials and Supplies	4,206,299	992,499	462,181	11,403	5,672,381
17	Prepayments	1,232,445	290,802	135,419	3,341	1,662,007
18	Deferred Charges:	592,462	139,794	65,099	1,606	798,961
19	Gas Stored Underground	25,872,855	15,166,248	16,221,291	486,639	57,747,033
20	Unamortized Software	6,394,853	1,107,770	16,969	101	7,519,693
21	***Rate Base Subtractions***					
22	Customer Deposits	-	-	-	-	-
23	Construction Advances	(28,684,419)	(4,968,955)	(76,115)	(452)	(33,729,941)
24	Net Asset Retirement Obligation	(465,837)	(198,520)	(179,362)	(5,369)	(849,088)
25	Deferred Investment Tax Credit	(3,375)	(1,438)	(1,300)	(39)	(6,152)
26	Deferred Income Taxes	(13,799,986)	(5,533,029)	(4,787,438)	(143,228)	(24,263,681)
27	**NET RATE BASE**	**$ 135,390,809**	**$ 71,554,469**	**$ 76,317,306**	**$ 2,082,071**	**$ 285,344,655**
28	**CURRENT RETURN**	**-0.44%**	**-3.24%**	**10.27%**	**29.84%**	**1.95%**
29	**PROPOSED REVENUES @ Equal Returns**	**$ 60,307,342**	**$ 22,420,508**	**$ 18,551,823**	**$ 500,475**	**$ 101,780,148**

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Interclass Revenue Allocation

The Gas Company
Schedule 1.01
Interclass Revenue Allocation

Line No.		SC-1 Residential	SC-2 Commercial	SC-3 Large General Service	SC-4 Contract Service	SYSTEM TOTAL
1	REVENUES @ CURRENT RATES	46,852,966	13,306,308	19,139,709	923,900	80,222,883
2	RETURN @ CURRENT RATES	-0.44%	-3.24%	10.27%	29.84%	1.95%
3	RETURN INDEX	(0.22)	(1.66)	5.28	15.34	1.00
4	**PROPOSAL AT EQUALIZED RETURNS**					
5	PROPOSED REVENUES	60,307,342	22,420,508	18,551,823	500,475	101,780,148
6	PROPOSED INCREASE (DECREASE)	13,454,375	9,114,200	(587,886)	(423,425)	21,557,265
7	PERCENT INCREASE (DECREASE)	28.72%	68.50%	-3.07%	-45.83%	26.87%
8	PROPOSED NET OPERATING INCOME	12,862,127	6,797,675	7,250,144	197,797	27,107,742
9	RETURN	9.50%	9.50%	9.50%	9.50%	9.50%
10	RETURN INDEX	1.00	1.00	1.00	1.00	1.00
18	**CONSTRAINED PROPOSAL (BASED ON ECOSS)**					
19	CONSTRAINED REVENUES	56,223,560	22,420,508	18,551,823	923,900	98,119,791
20	PROPOSED INCREASE (CONSTRAINED CLASSES)	9,370,593	-	-	-	
21	PERCENT INCREASE (CONSTRAINTS)	20.00%	NONE	NONE	0.00%	
22	REVENUE SHORTFALL FROM CONSTRAINTS	3,660,357				
23	REALLOCATION OF SHORTFALL	-	2,002,988	1,657,370	-	
24	PROPOSED REVENUES (CONSTRAINED)	56,223,560	24,423,496	20,209,193	923,900	101,780,148
25	PERCENT INCREASE (ALL CLASSES)	20.00%	83.55%	5.59%	0.00%	26.87%
26	PROPOSED NET OPERATING INCOME	8,778,345	8,800,662	8,907,514	621,221	27,107,742
27	RETURN	6.48%	12.30%	11.67%	29.84%	9.50%
28	RETURN INDEX	0.68	1.29	1.23	3.14	1.00

Incentives v. Cost Recovery

Economists: View world through lens of **incentives**.

Decentralized decisions

Price is a **<u>signaling device</u>**

Result: People make good decisions, and the result is best for everyone

Engineers: View world through lens of **problem solving**.

Concerned about making the best decision about deploying resources to meet the objectives of the investment

Price is a **<u>cost recovery mechanism</u>**

Result: Planners make good decisions, and the result is best for everyone

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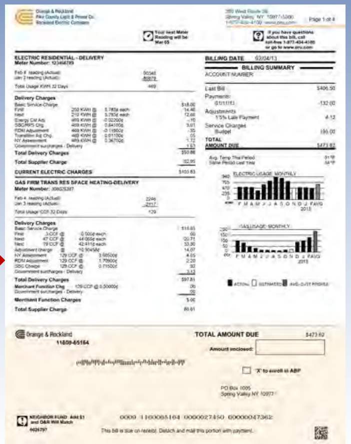
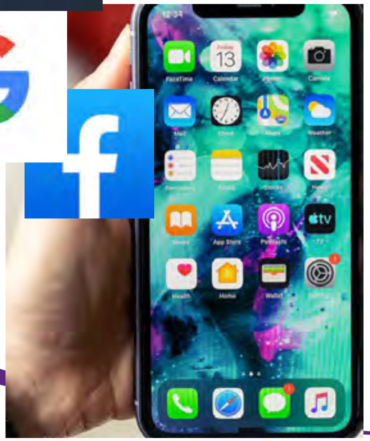
Why Does Pricing Matter?

OLD WORLD



Price



The Bonbright Criteria for Sound Rate Structure

Revenue-related attributes

- Effective at yielding total revenue requirement without increase rate base beyond what is necessary or creating incentive for undesirable product quality
- Revenue stability and predictably
- Stable rate structures

Cost-related attributes

- Static efficiency (efficient control of demand and supply)
- Reflection of total costs and benefits (including externalities)
- Fairness as to the allocation of costs to address these equity concerns (1) horizontal (treating equals as equals); (2) vertical (unequals treated unequally) and (3) anonymous (avoid uneconomic bypass)

Practical attributes

Simplicity, convenience of payment, feasibility, understandability, public acceptance

Rates should be free from interpretation controversy

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Economist Approach to Pricing

Define the value of a transaction

consumer surplus and producer surplus (i.e., profit).

Competitive markets maximize consumer surplus

Optimal pricing asks the question

Price such that, subject to the break-even constraint, surplus is maximized

Two things to remember

Total surplus = consumer surplus plus producer surplus. The economics **does not** differentiate between the two.

Surplus (always) increases if the **quantity sold increases**

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Is that how regulators look at it?

- **Does not matter who gets the surplus if it is as large as possible**
  - Most regulators charged with balancing the interests of consumers and utilities
- **Surplus increases if quantity increases**
  - Many regulators charged with promoting lower sales due to climate change concerns
- **Pricing in practice does not seem to fit pricing in theory**

Is that how regulators look at it?

Rate Structure	Pros	Cons
Flat	Easy to understand All units prices the same	Cost to serve additional units may be higher or lower
Declining Block	If costs fall with additional units, better price signals	Harder to understand Promotes more usage at higher levels
Inclining Block	If costs rise with additional units, better price signals Promotes lower usage at higher levels	Harder to understand Promotes lower usage at higher levels
Demand Rates	Incentive to increase load factor Promotes more efficient use of network	Harder to understand (for unsophisticated customers) Harms low load factor customers with no ability to alter load

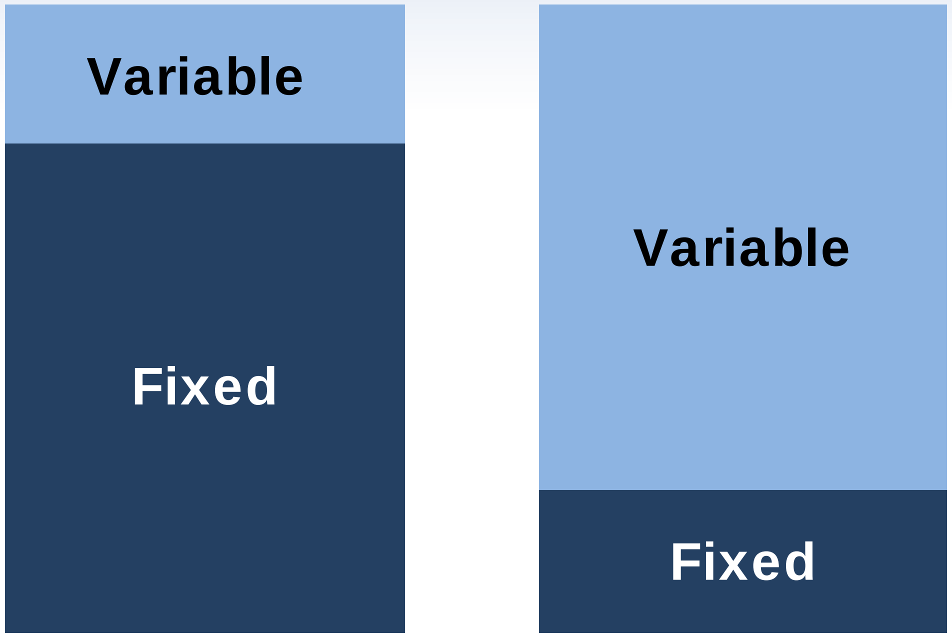
How do Current Rates Match Up with Costs?

Cost Categories | **Cost Structure** | **Rate Structure**

Variable
- Supply
- O&M

Fixed
- Customer (Metering, billing, services)
- A&G

Demand
- Transmission Capacity
- Distribution Capacity



What is the solution?

Industry: Higher fixed charges

- SFV (for residential this normally means much higher customer charge)
- Demand rates
- Fixed fees should recover fixed costs
- Many examples of fixed fees (Amazon, Costco, parking garages, etc.)
- Outside utilities, no other industry is required by law to pay consumers to use less of the product

Counter argument: Higher variable charges

- Fixed costs are a short-run concept, all cost are variable in long run
- No economics behind "fixed fees recover fixed costs"
- High fixed charges prevent price responsive demand
- Low-income consumers hurt by high fixed charges
- No competitive firms charge fixed fees (indicative of market power)

Pricing Issues Today

Innovation Lagging: Natural gas pricing largely lags the electric industry.

- Time of use not as important
- Uses of gas less diverse
- AMI and other technologies have lower penetration rates
- Gas demand side response is longer term than electric

Some movement:

- Demand-based charging and seasonal or peak rates (e.g., AGL, SoCalGas)
- Expansion rates (Gas AC, NGV, co-generation or other DER)
- Fixed charges
- Non-pipes solutions (e.g., ConEd targeting electrification of buildings)
- Line extension pricing (incremental v. rolled-in)

Current and Future Issues

Climate change: Gas can be part of solution v. coal, but is it really a transition fuel?

Lower usage makes gas utilities less attractive to investors and more costly to consumers (at least for delivery)

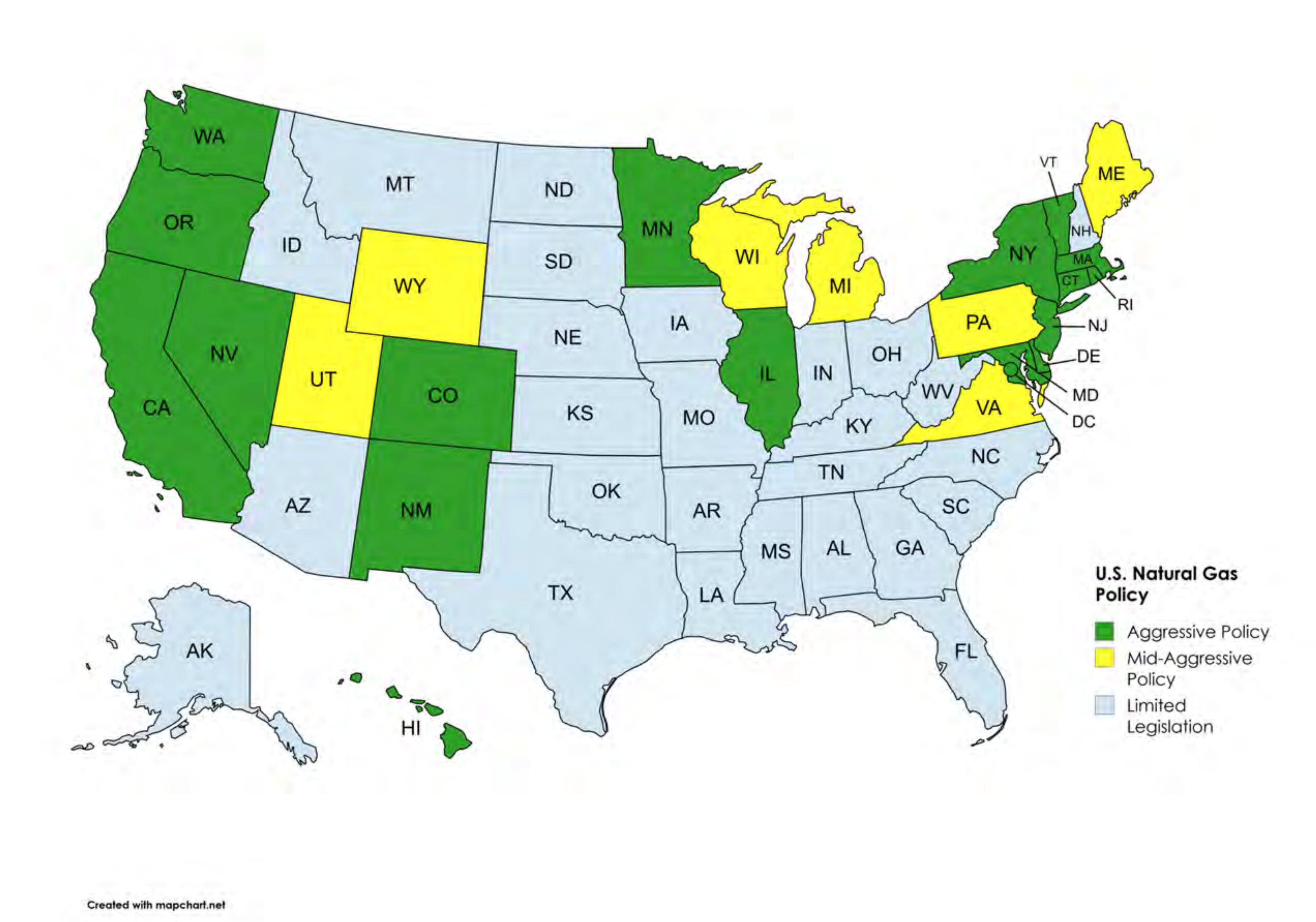
Need to maintain current facilities

- Transport and storage constraints (NE, CA, etc.)
- While average prices are generally low very high prices can occur behind bottlenecks
- What about expansion (line extension policies)

Future of Gas

- Biogas potential, competitive storage, more information to consumers
- Electrification (space heating, water heating)
  - …residential..[electric space heating applications]…are approaching cost parity with incumbent natural gas technologies in moderate to warm climates, but in cold climates, incumbent gas technologies…exhibit…[cost advantage]" NREL "Electrification Futures Study," 2017 (with caveats re: high regional gas prices)
- Gas demand management
  - Better pricing with AMI metering
  - Can DR save the day in transport tight regions?

Future of Gas



Appendix 1

Two Versions of Bonbright Principles

Bonbright Principles

Bonbright (1961, p. 291)	Bonbright, Danielsen and Kamerschen (1988, pp.383-384)
The related, "practical" attributes of simplicity, understandability, public acceptability, and feasibility of application.	The related, "practical" attributes of simplicity, certainty, convenience of payment, economy in collection, understandability, public acceptability, and feasibility of application.
Freedom from controversies as to proper interpretation.	Freedom from controversies as to proper interpretation.
Effectiveness in yielding total revenue requirements under the fair-return standard.	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.

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Bonbright Principles

Bonbright (1961, p. 291)	Bonbright, Danielsen and Kamerschen (1988, pp.383-384)
Revenue stability from year to year.	Revenue stability from year to year with a minimum of unexpected changes seriously adverse to utility companies.
Stability of the rates themselves, with minimum of unexpected changes seriously adverse to existing customers. (Compare "The best tax is an old tax.)	Stability of the rates themselves, with a minimum of unexpected changes seriously adverse to ratepayers and with a sense of historical continuity. (Compare "The best tax is an old tax.)
Fairness of the specific rates in the apportionment of total costs of service among the different customers.	Fairness of the specific rates in the apportionment of total costs of service among the different ratepayers so as to avoid arbitrariness and capriciousness and to attain equity in three dimensions: (1) horizontal {i.e., equals treated equally); (2) vertical {i.e., unequals treated unequally); and (3) anonymous (i.e., no ratepayer's demands can be diverted away uneconomically from an incumbent by a potential entrant).

Bonbright Principles

Bonbright (1961, p. 291)	Bonbright, Danielsen and Kamerschen (1988, pp.383-384)
Avoidance of “undue discrimination” in rate relationships.	Avoidance of “undue discrimination” in rate relationships so as to be, if possible, compensatory (i.e., subsidy free with no intercustomer burdens).
Efficiency of the rate classes and rate blocks in discouraging wasteful use of service while promoting all justified types and amounts of use:	Static efficiency of the rate classes and rate blocks in discouraging wasteful use of service while promoting all justified types and amounts of use:
(a) in the control of the total amounts of service supplied by the company;	(a) in the control of the total amounts of service supplied by the company;
(b) in the control of the relative uses of alternative types of service (on-peak versus off-peak electricity, Pullman travel versus coach travel, single-party telephone service versus service from a multi-party line, etc.)	(b) in the control of the relative uses of alternative types of service (on-peak versus off-peak service or higher quality versus lower quality service).

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Bonbright Principles

Bonbright (1961, p. 291)	Bonbright, Danielsen and Kamerschen (1988, pp.383-384)
	Reflection of all the present and future private and social costs and benefits occasioned by a service's provision (i.e., all internalities and externalities.) Dynamic efficiency in promoting innovation and responding economically to changing demand and supply programs.

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Thank You

Carl Peterson

Instructor

Department of Accounting, Economics, and Finance | University of Illinois Springfield

One University Plaza MS UHB 4093 | Springfield, IL 62703 USA

Tel: +1 312.287.0127 | cpeter8@uis.edu

Executive Advisor
Concentric Energy Advisors, Inc.
Chicago, IL USA
Tel: +1 312-287-0127 | cpeterson@ceadvisors.com