Water utility pricing and affordability

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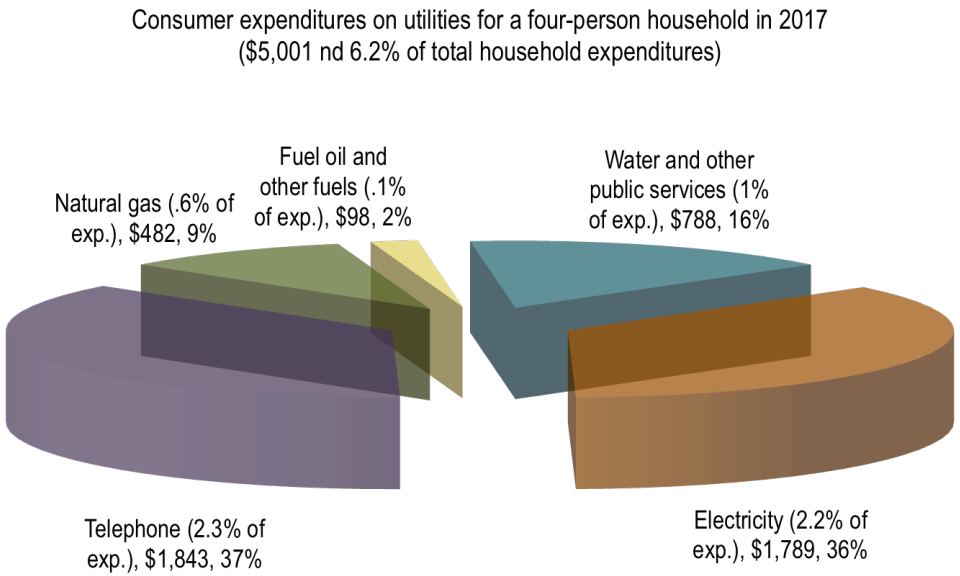
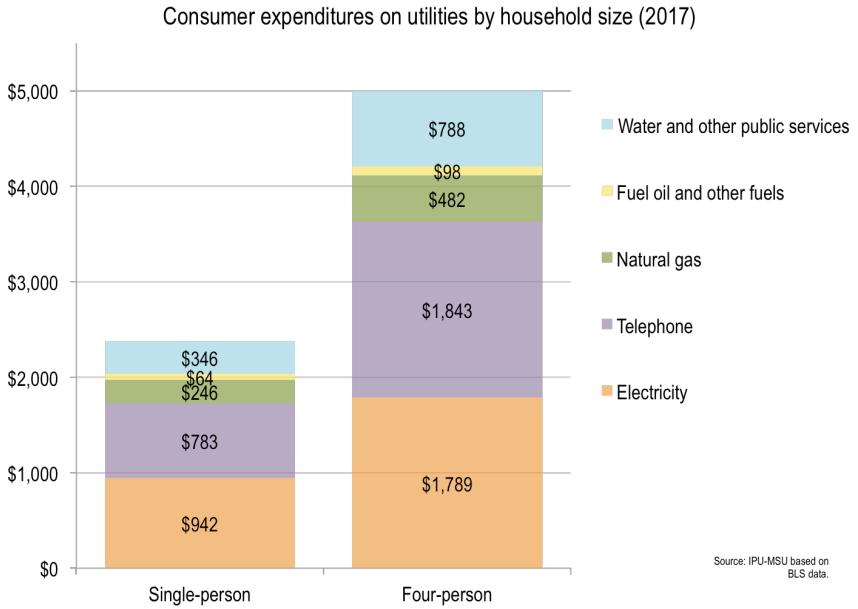
MICHIGAN STATE UNIVERSITY

Household expenditures on utilities in the U.S.

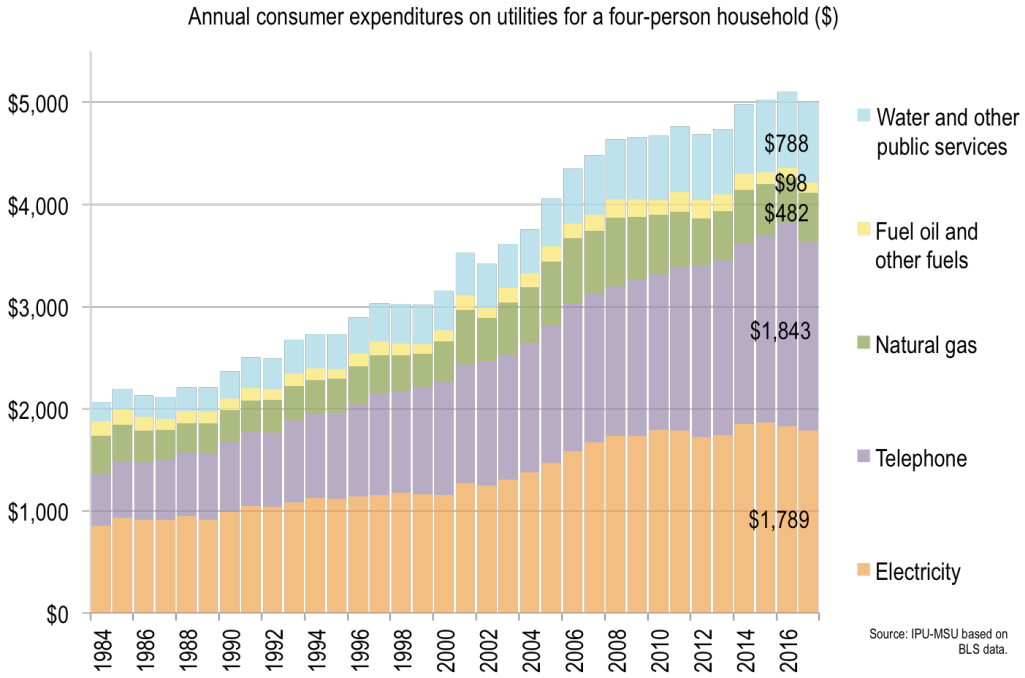


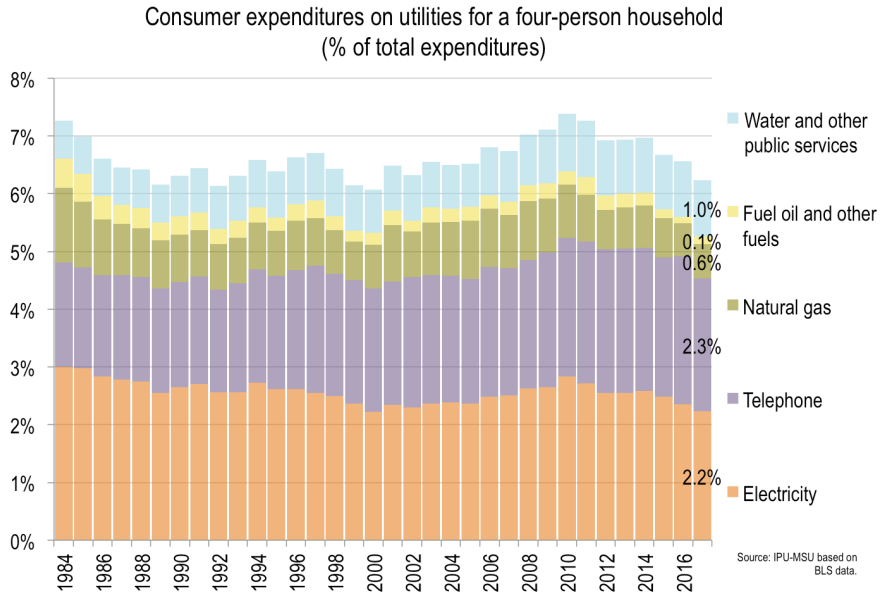
Source: IPU-MSU based on BLS data.



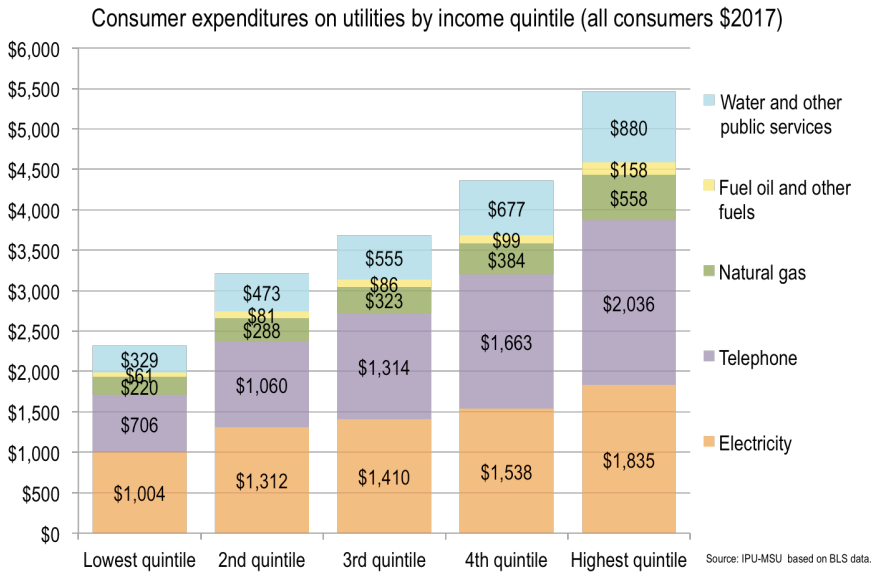
Source: IPU-MSU based on BLS data.

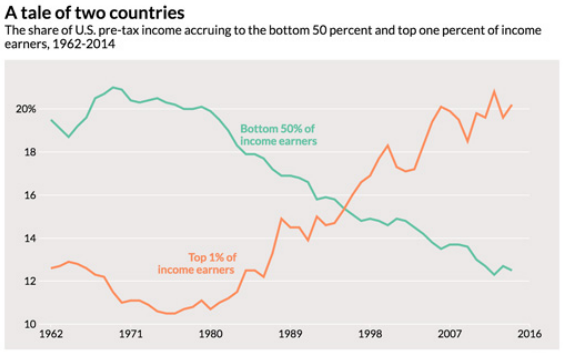
Household expenditures on utilities over time

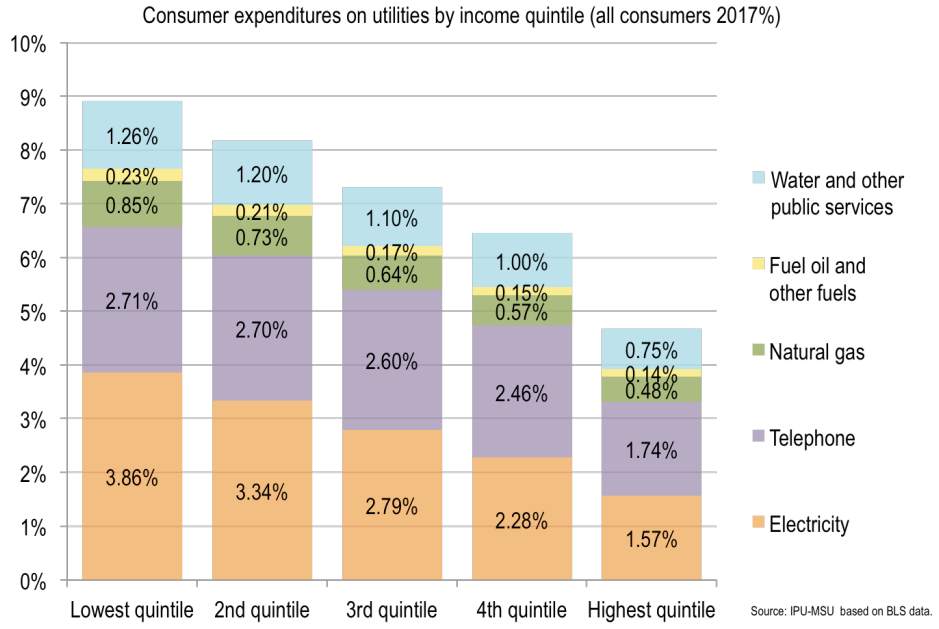




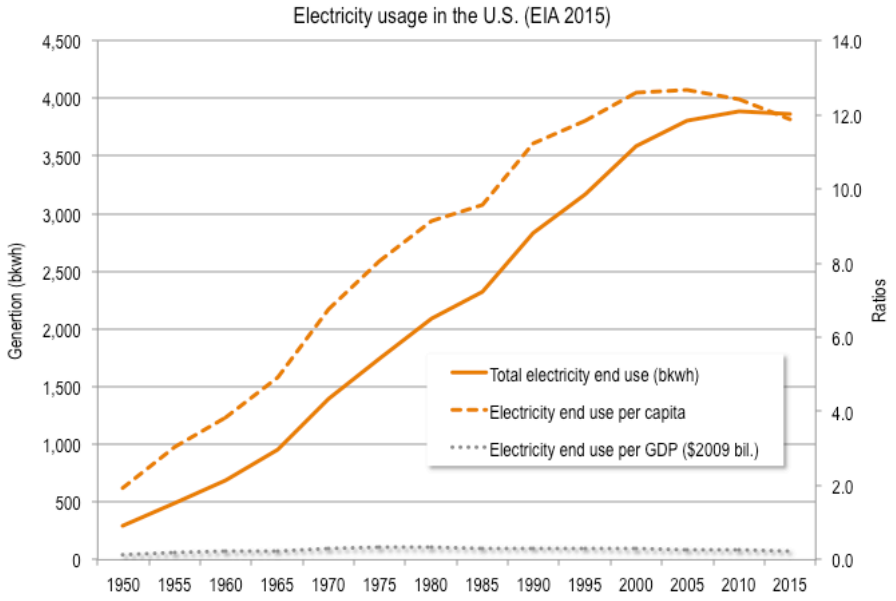
Utilities expenditures by income level and regressivity

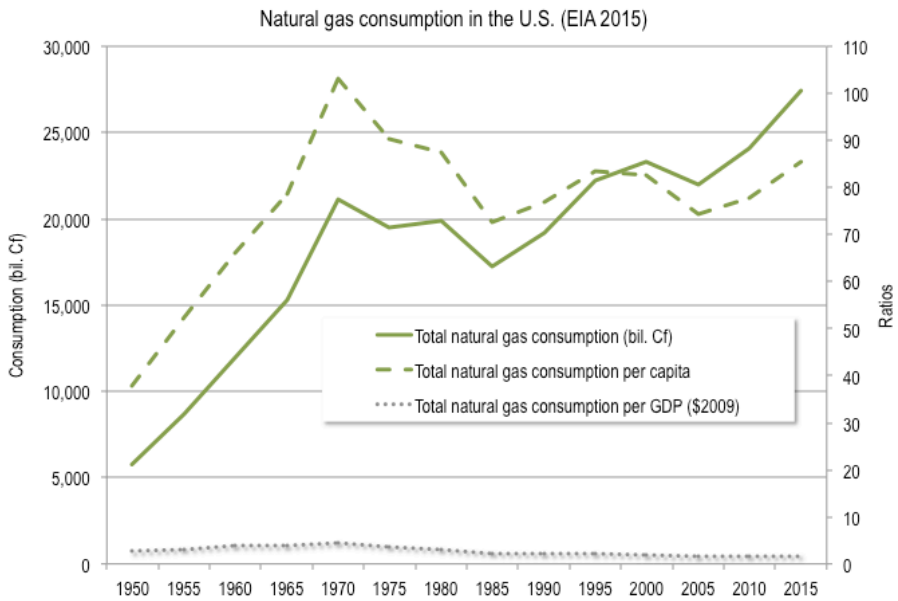


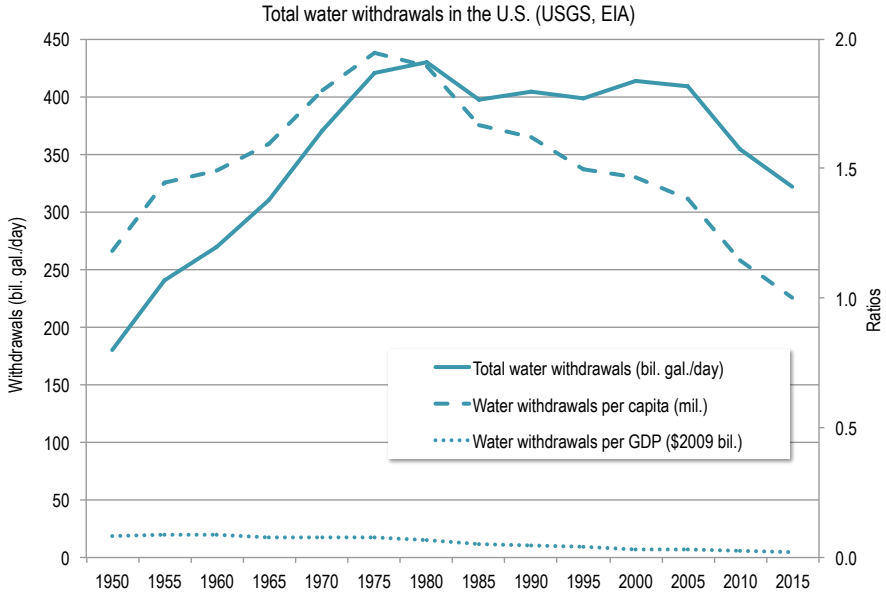




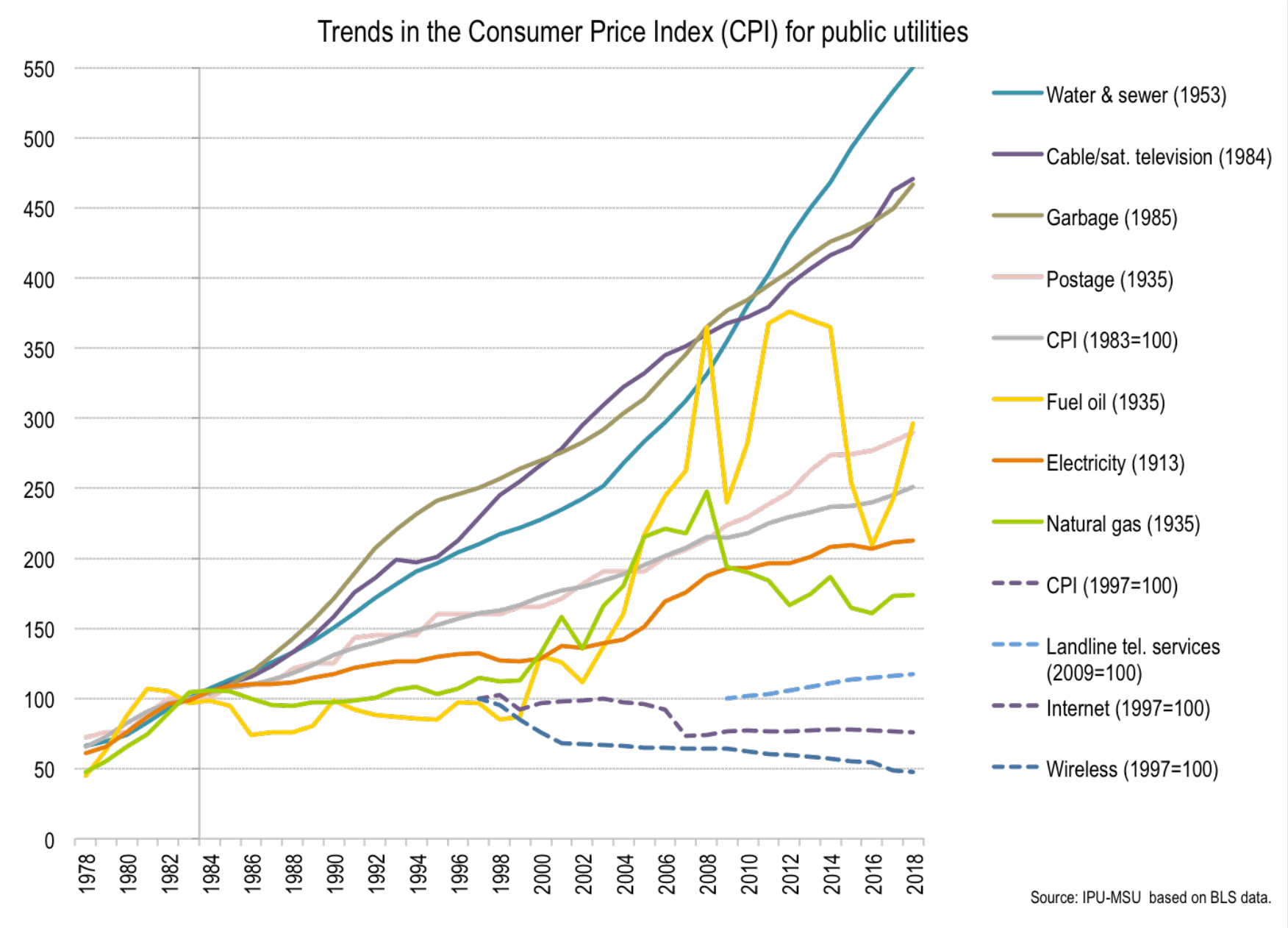
Aggregate trends: electricity, gas, and water



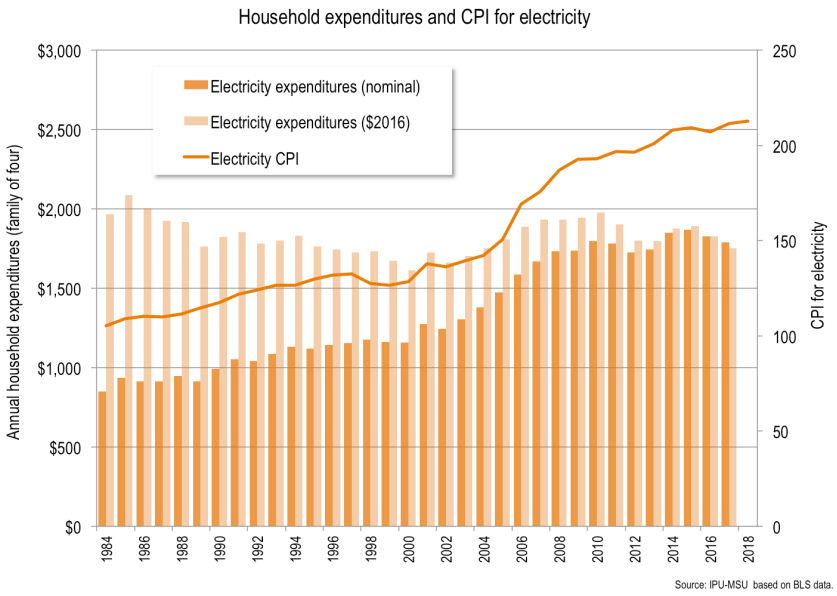


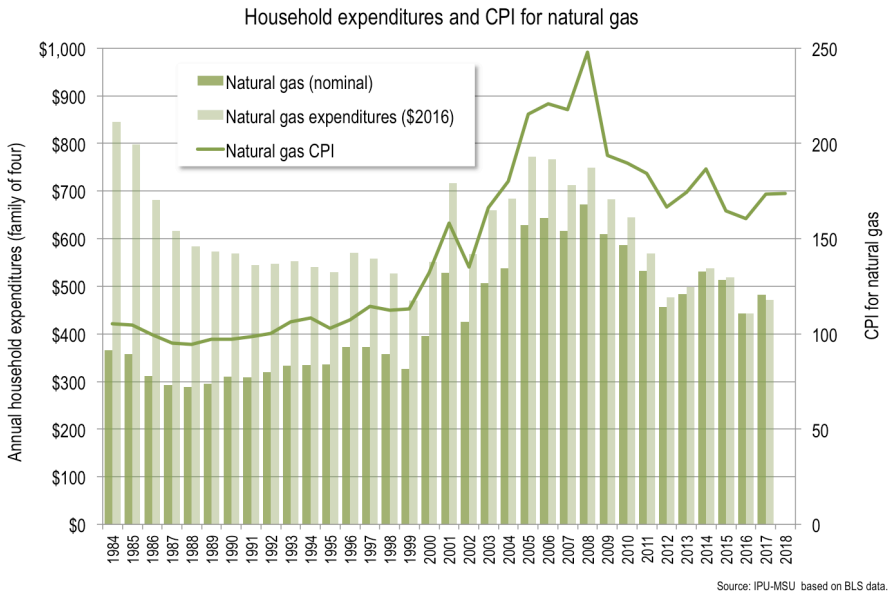


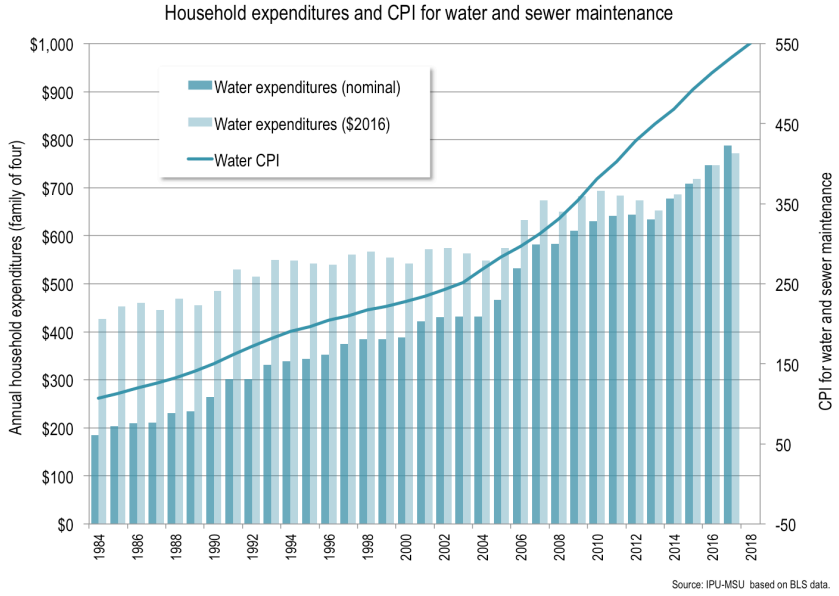
CPI trends for utilities (US)



Expenditure and price trends combined

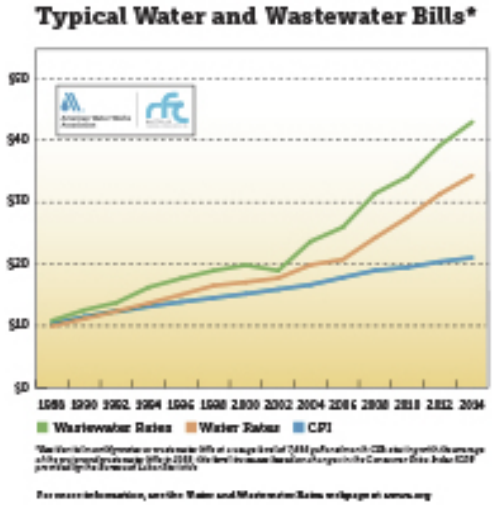






Inflationary pressure on water costs and prices

- Water system cost and price profiles vary substantially
  - By system type, age, and location
  - Combined water, wastewater, stormwater – possible crowding re water affordability
  - Prices of privately owned systems are higher (taxes, returns, practices)
- Capital cost pressures
  - Combined infrastructure needs of $1 trillion over next 25 years
  - Asset valuation at fair value and private investment
- Operating cost pressures
  - Labor, energy, chemicals, and purchased water
  - Quality standards and compliance costs
  - Lead service line replacement
  - New contamination threats
  - Water supply constraints
  - Population growth (locational)



- Flat or declining water usage (pricing, programs, population, recession)
- Move to full-cost pricing as fiscal necessity for local government (vs. taxes)
  - Promoted as “rational” by economists, consultants, and regulators (including USEPA)
  - Investor-owned utilities invariably charge full cost, including overhead, taxes, & returns

Water infrastructure needs

Investment Gaps and Potential Sources of Funding

	Transportation	Water	Communications	Energy
Forecasted Annual Investment Gaps	$2.7 billion	$1 billion	$70 million	N/A Largely private utility investment
Forecasted Investment Gaps Over the Next 20 Years	$40 billion	$19 billion*	$600 million	N/A
Potential Sources of Funding	• Federal funding • Mileage-based user fee • Gas tax increase • Registration fee increase • Local revenue options expansion • Public and private partnerships	• Water rates aligned with investment needs • Water infrastructure user fees	• Private investment • Federal funding • Provider rights-of-way fee increases • Subscriber surcharges	• Private investment • Continual improvements and updates in the state and federal decision-making processes
	• Dedicated sales tax for infrastructure • Dedicated statewide property tax			

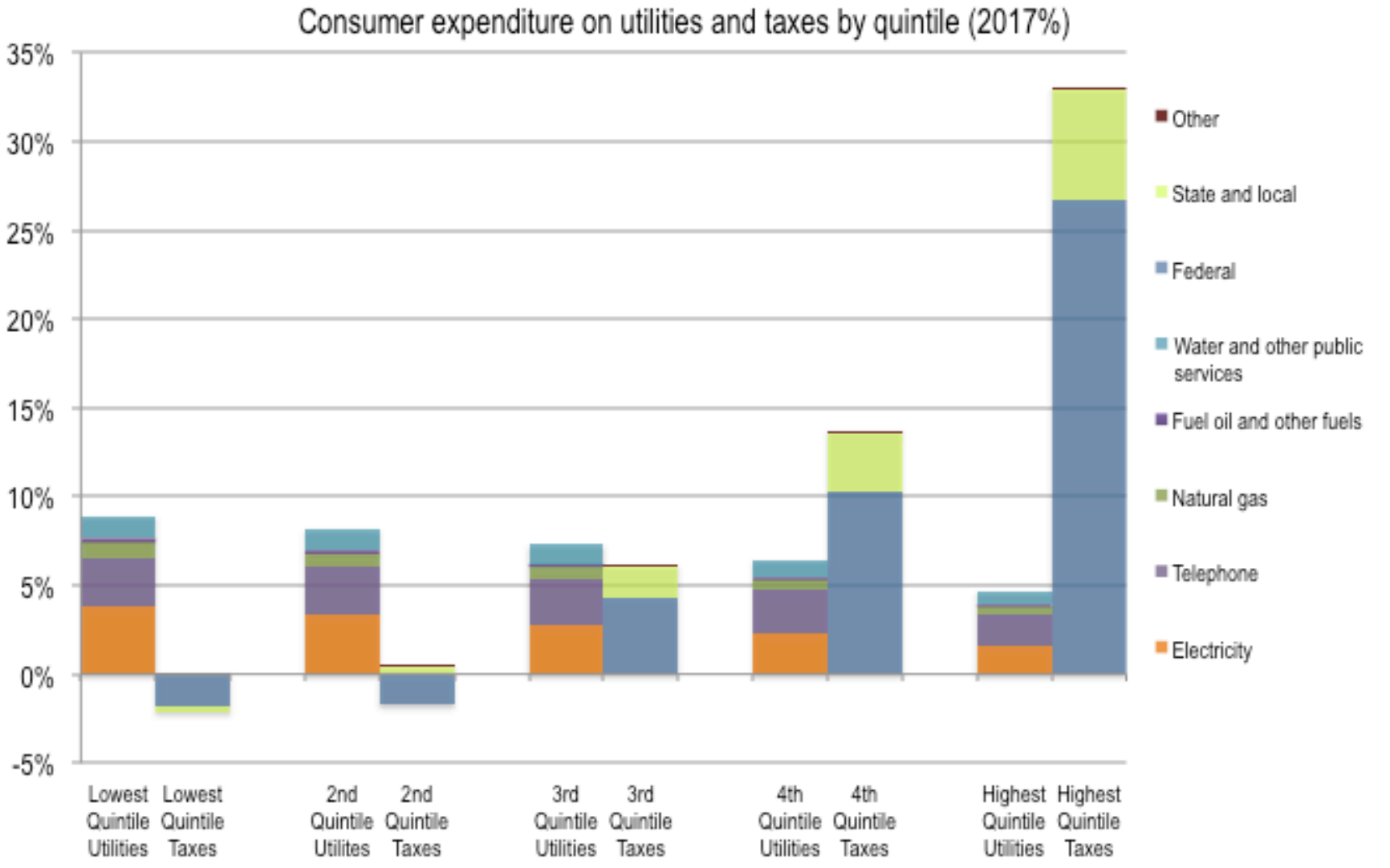
* This figure includes an estimated $600 million annual gap in water and sewer infrastructure needs. This is considered a conservative estimate using the best information available. As condition assessments are completed, this estimate is expected to increase.

Infrastructure funding vs. financing

- Funding for infrastructure is from taxpayers or ratepayers or both
  - Taxes (federal, state, or local) vs. user fees and charges (increasingly)
  - Rates are more regressive and taxes can be less regressive
  - Capital financing comes from debt or higher cost private debt and equity
  - Funding & financing options can be combined - privatization is not a source of “funding”
- Utility enterprise model and full-cost pricing are strongly favored over taxes
  - Regardless of ownership form or economic and social basis – vs. historical experience
  - Institutional constraints undermine investment and pricing (MI’s Headlee and Bolt)

		Capital financing (providers)	
		Public (debt and public equity)	Private (debt and private equity)
Capital funding (users)	User fees	Public enterprise	Private enterprise
	Taxes	Public service	Private partnership

Differential effects of utility rates and taxes

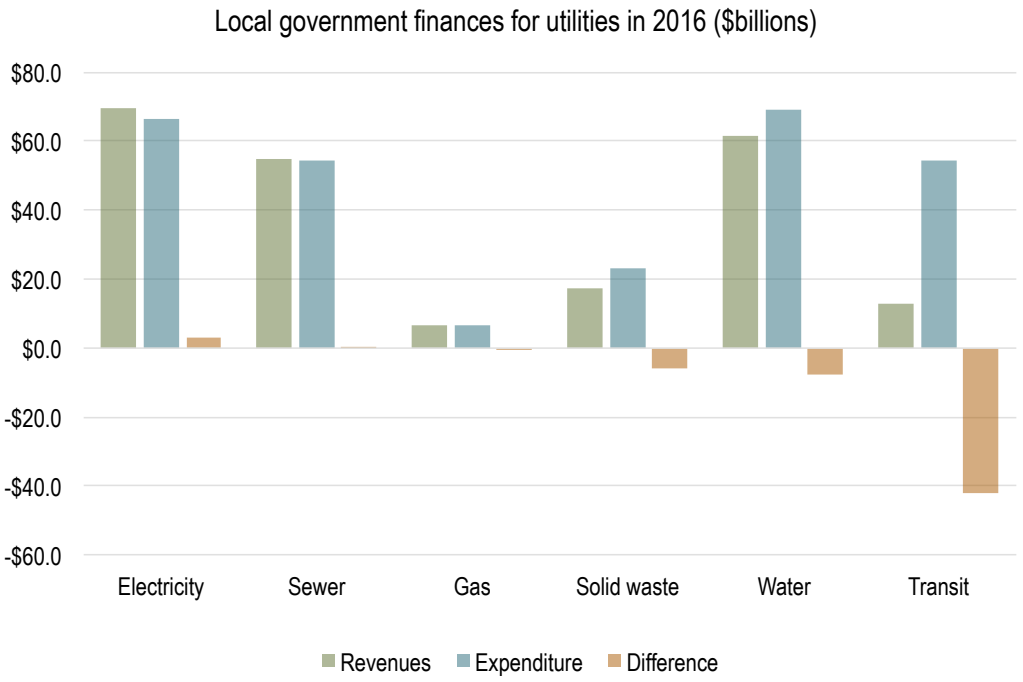


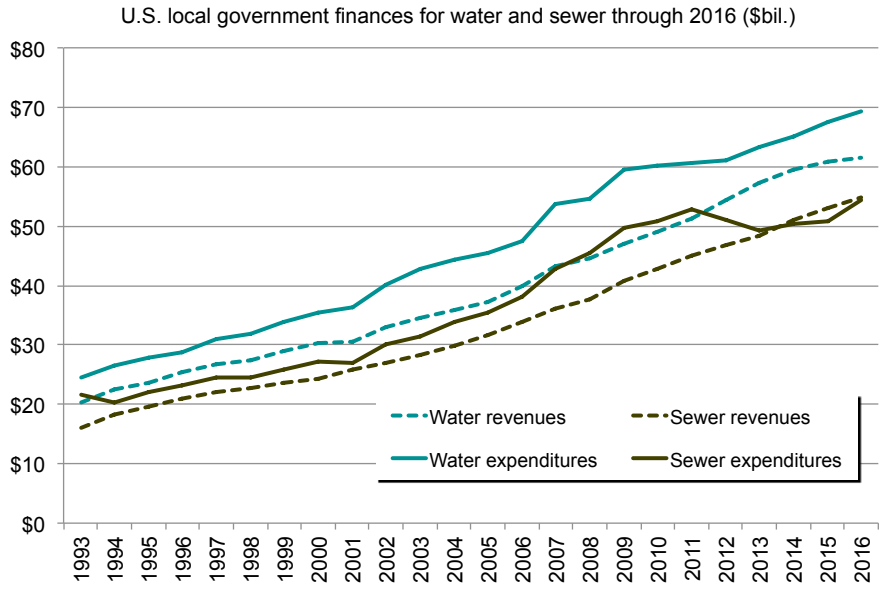
Source: IPU-MSU based on BLS data.

Paying for infrastructure: Michigan's rock and a hard place

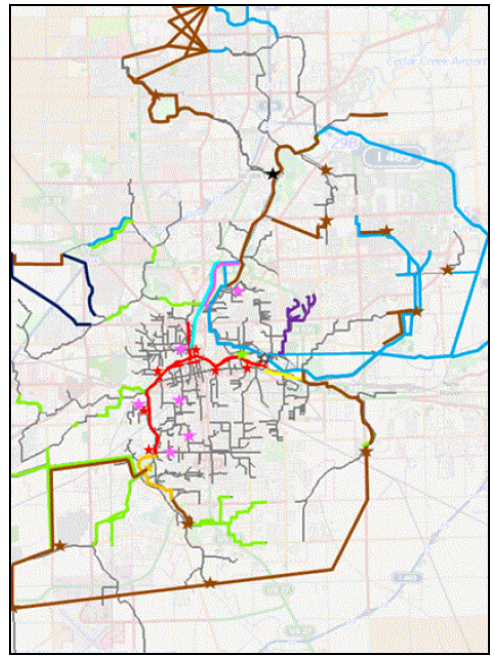
- The rock of no taxes
  - Headlee amendment to the Michigan Constitution (1978)
  - Sec. 26. "There is hereby established a limit on the total amount of taxes which may be imposed by the legislature in any fiscal year on the taxpayers of this state. This limit shall not be changed without approval of the majority of the qualified electors voting thereon…"
  - Sec. 31. "Units of Local Government are hereby prohibited from levying any tax not authorized by law or charter when this section is ratified or from increasing the rate of an existing tax above that rate authorized by law or charter when this section is ratified, without the approval of a majority of the qualified electors of that unit of Local Government voting thereon..."
- The hard place of no user fees
  - According to Bolt v. City of Lansing (1998) a service fee must
    - serve a regulatory purpose rather than a (general) revenue raising purpose;
    - be proportionate to the necessary cost of the service; and
    - be voluntary in that users can refuse or limit their use of the commodity or service.
  - "We conclude that the storm water service charge imposed by Ordinance 925 is a tax 273*273 and not a valid user fee. To conclude otherwise would permit municipalities to supplement existing revenues by redefining various government activities as "services" and enacting a myriad of "fees" for those services. To permit such a course of action would effectively abrogate the constitutional limitations on taxation and public spending imposed by the Headlee Amendment…"

Publicly owned utilities: local finances





Closing the funding gap



- Closing the funding gap from the top – lower costs
  - Efficiency practices
  - Technological innovation
  - Market-based approaches (bidding)
  - Industry restructuring
  - Integrated resource and asset management
  - System (re)optimization relative to demand
- Closing the funding gap from the bottom – raise funding
  - Public funding for infrastructure (taxes, e.g., transportation)
  - Cost-based rates for water services (user fees)
  - Comprehensive economic regulation by PUCs address costs and rates
  - EPA's four pillars: management, efficiency, pricing, watershed protection
- Some communities might avoid necessary investment
  - Avoiding politically unpopular rate increases and addressing affordability
  - These are separable issues

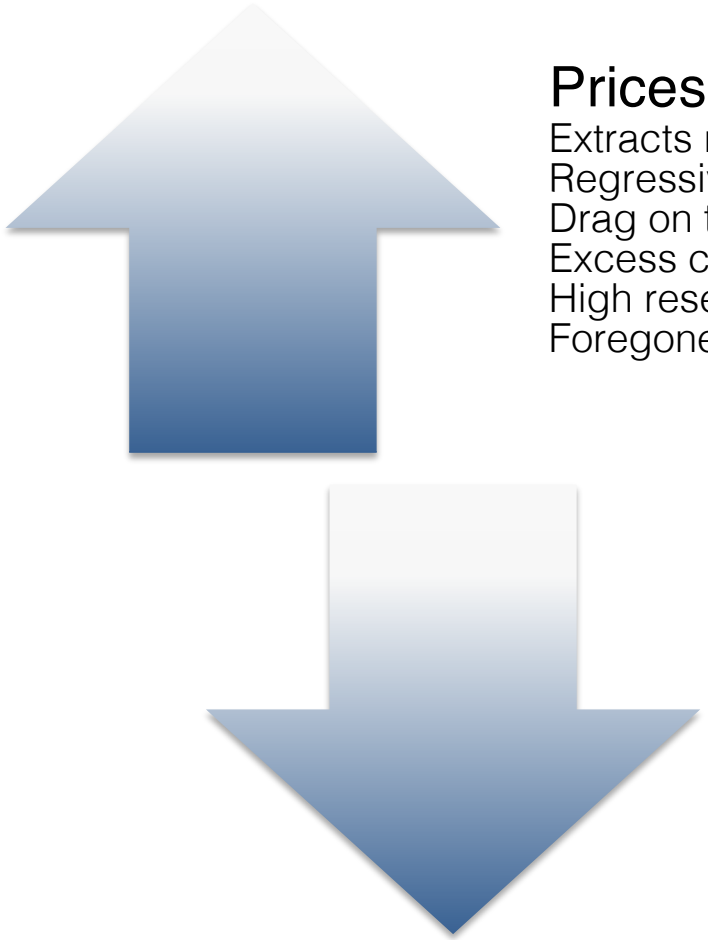
Sustainable utility enterprises

System revenues relative to expenditures	System expenditures relative to optimized compliant service level		
	< 1 expenditures below optimum ("cost avoidance")	= 1 expenditures are optimal	> 1 expenditures above optimum ("gold plating")
< 1 revenues are below expenditures ("price avoidance")	Deficient system	Subsidized system	Budget-deficit system
= 1 revenues are equal to expenditures	Underinvesting system	SELF-SUSTAINING SYSTEM	Overinvesting system
> 1 revenues are above expenditures ("profit seeking")	Revenue-diverting system	Surplus system	Excessive system

Cost of service and its recovery

Societal level		System level			Ratepayer level
Full social or "true" cost	Full economic cost	Full-cost accounting	Full-cost recovery	Full-cost pricing	Fully allocated pricing
Environmental, economic, social externalities (spillovers)	I I I I V	I I I I V	I I I I V	I I I I V	I I I I V
Opportunity and avoided costs		I V	I V	I V	I V
Accounting costs		• Capex (financing) • Opex • Depreciation • Taxes • Reserves	• Federal and state grants • Lease and other income • Property taxes • General fund transfers	I I I I V	I I I I V
			• Customer rates • Other user fees and charges • System development charges (growth)		Individualized based on cost causality

Economics of price signals and welfare effects



Prices too high

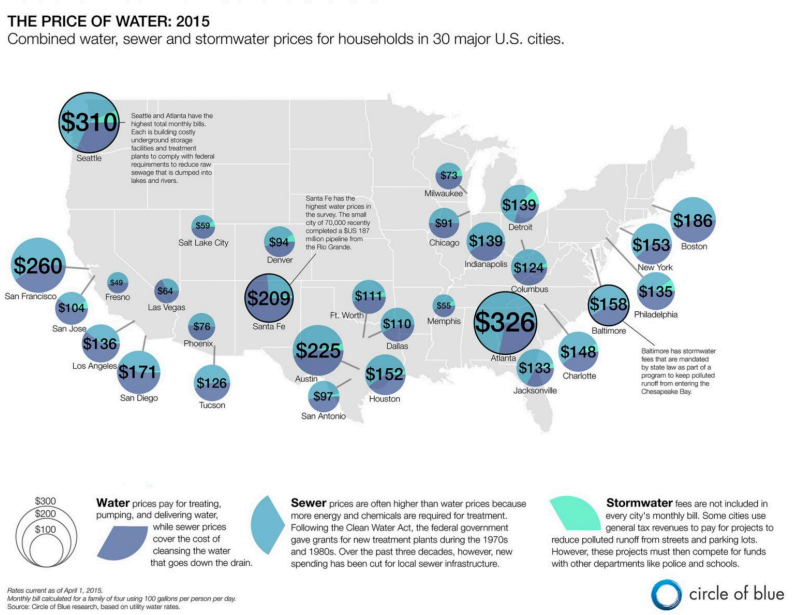
Extracts rents from essential usage (Ramsey pricing)
Regressive deprivation and endangerment
Drag on the local economy (income effect)
Excess capacity and stranded investment
High reserves and transfers from system
Foregone revenues lost sales, theft, bypass, defection

Prices too low

Weakens price signals for discretionary usage
Excessive and wasteful use of resources
Inadequate infrastructure investment
Poor capacity utilization and congestion
Low reserves and subsidies to system
Financial effects of revenue inadequacy

Modern criteria for evaluating utility rates*

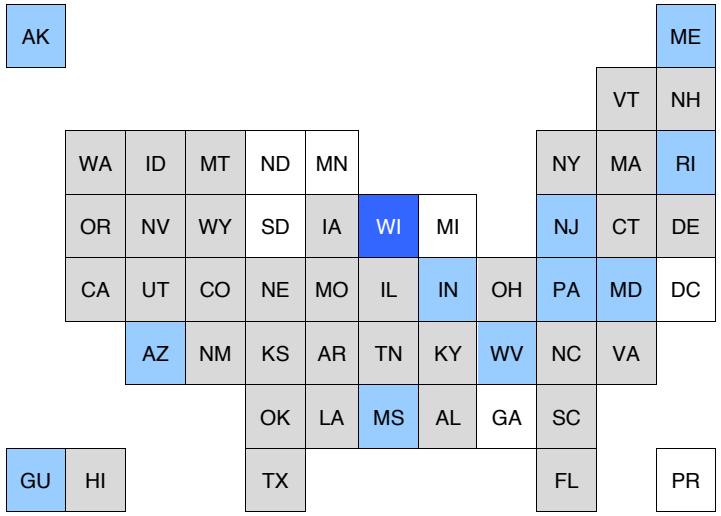
- Criteria
  - Financial viability
  - Economic efficiency
  - Equitable allocation
  - Operational performance
  - Network optimization
  - Environmental stewardship (social equity)
  - Distributive justice (social equity)
- Constraints and considerations
  - Understandable, unambiguous, transparent
  - Technically feasible and cost effective
  - Legally defensible and politically acceptable



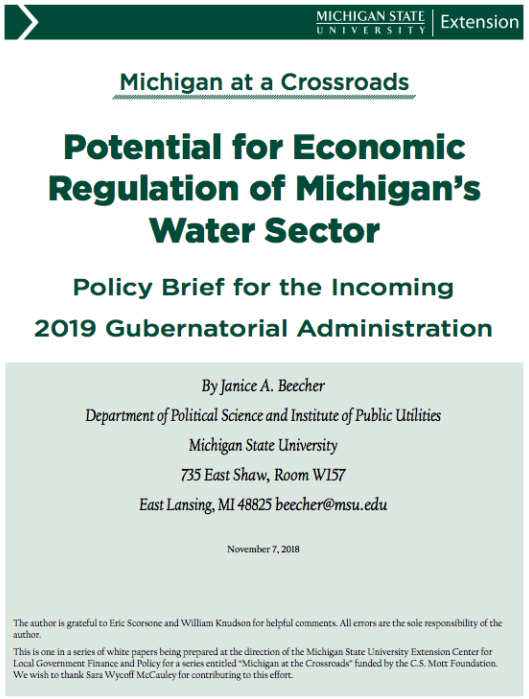
*Building on Bonbright (1961)

Economic regulatory jurisdiction for water

- Michigan is one of six U.S. jurisdictions that has no economic regulatory jurisdiction for the water sector
  - Wisconsin fully regulates all municipal energy and water utilities
- Regulation "in the public interest" is protective of both utilities and ratepayers
  - Substitutes both for competitive market and governmental provision of the monopolies providing essential services at "just and reasonable" rates
  - Multiple implementation models are available



IPU**MSU**
Source: Surveys by IPU and Wisconsin PSC.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Michigan at a Crossroads

Potential for Economic Regulation of Michigan's Water Sector

Policy Brief for the Incoming 2019 Gubernatorial Administration

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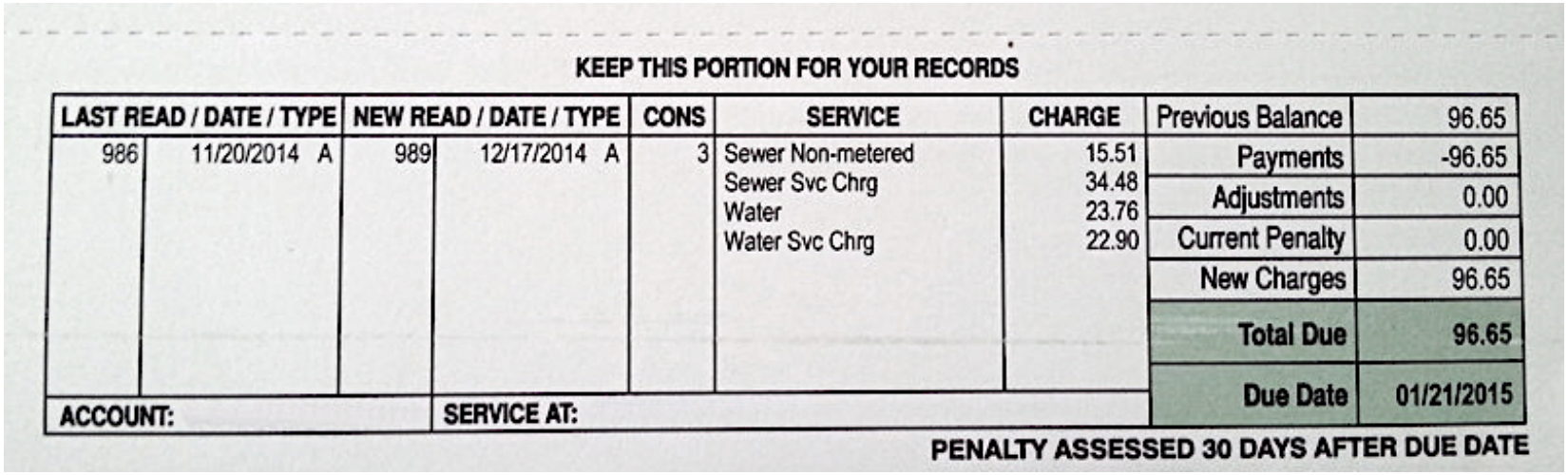
Defining affordability for water (AWWA, M1)

- Affordability may be defined in terms of the ability of
  - Poorest households in the service area to afford their water and wastewater bills
  - Average or median household in the service area to afford its water and wastewater bill
  - An unconnected household or business to afford connection
  - Community to bear the total costs of providing water infrastructure and services
  - Community to afford these costs as measured by the USEPA or other relevant entities
- How USEPA measures affordability for regulatory purposes (currently debated)
  - Water at 2.5% of MHI and wastewater at 2% of MHI (4.5% total)
  - Infers a combined annual water and wastewater bill of 4.5%
  - AWWA and others have adopted similar metrics



KEEP THIS PORTION FOR YOUR RECORDS

LAST READ / DATE / TYPE		NEW READ / DATE / TYPE		CONS	SERVICE	CHARGE
986	11/20/2014 A	989	12/17/2014 A	3	Sewer Non-metered	15.51
					Sewer Svc Chrg	34.48
					Water	23.76
					Water Svc Chrg	22.90

Previous Balance	96.65
Payments	-96.65
Adjustments	0.00
Current Penalty	0.00
New Charges	96.65
Total Due	**96.65**
Due Date	**01/21/2015**

ACCOUNT: SERVICE AT:

PENALTY ASSESSED 30 DAYS AFTER DUE DATE

Residential affordability metrics (Haas)

Residential Indicator Alternatives			
Options	**WATER COSTS INCLUDED**	**HOUSEHOLD INCOME**	**OTHER METRICS**
EPA 1997 Formula	CSO/SSO Costs	Median Household Income (MHI)	• Cost/MHI greater than 2% = High burden

EPA 2014 Framework	CSO/SSO Costs + Stormwater Costs	MHI	• **Supplementary data**
			  ○ Quintile income distribution national average
			  ○ Poverty rates and trends
			• **Supplementary data**
			  ○ Clean water costs per income quintile

EFAB 2007	All Water Costs	Income by Quintile	• Projected water costs and income levels • Composite metric including Poverty rate and Income distribution

EFAB 2014	All Water Costs	Income by Quintile
		Income by geographic area (e.g., Census tracts)
			• **Trends and projections of costs and income**
			• **Composite metric including**
			  ○ Poverty rate + income distribution
			  ○ Cost of living differences
			  ○ Housing cost burden (renters + owners)
			  ○ Non-residential user impacts

Mayors/AWWA 2013	Average Water Bill	Income by Quintile Income for poor, elderly, or renters Income for poor areas	• Non-discretionary expenses as % of income by Quintile • Poverty Rate • High Housing Cost Burden • Percentage of the population eligible for LIHEAP
NACWA 2013	Projected Water Bill	Income by Quintile—especially Lowest Quintile (LQI) projected	• Burden on Sub-populations within service area

Residential affordability metrics (Teodoro, 2018)

- Conventional methods are flawed and may be misleading
- Proposed method
  - Measures household-level affordability (rather than the entire utility's financial capability)
  - provides for basic water needs (rather than average consumption)
  - Focuses on low-income households (not average- or median-income customers)
  - Accounts for essential costs other than water and sewer
- Two complementary metrics
  - AR = affordability ratio
  - AR20 = at the 20th income percentile
  - HM = hours of labor at minimum wage

TABLE 2 Affordability metrics for Dallas, Tex.[a]

A. Basic monthly water and sewer cost	$59.82
AR	
B. AR_{20} annual income	$18,585.00
C. Monthly income (B ÷ 12)	$1,548.75
D. Estimated monthly essential expenses[b]	$864.11
E. Monthly disposable income (C – D)	$684.64
AR_{20} (A ÷ E)	8.74%
HM	
F. Minimum wage per hour	$7.25
HM (A ÷ F)	8.25

AR—affordability ratio, AR_{20}—affordability at the 20th income percentile, HM—hours of labor at minimum wage

[a]Based on 2017 rates
[b]Estimates based on regression analysis of 2015 Consumer Expenditure Survey. See appendix.

Affordability policy options

- Payment credits or assistance (including voluntary funding)
- Tax exemption for water bills
- Arrearage forgiveness
- Budget billing
- Bill timing (monthly)
- Payment convenience (kiosks)
- Lifeline and other rate structures
- Smart meters (tamper resistant)
- Service limiters (time or flow limited)
- Coordinated outreach and counseling
- Disconnection policies (including prohibition)
- Tailored efficiency programs and dynamic pricing
- Prepaid meters (self-rationing, self-disconnection) – for everyone?
- Fixed charges calibrated to property values with usage allowance (water)

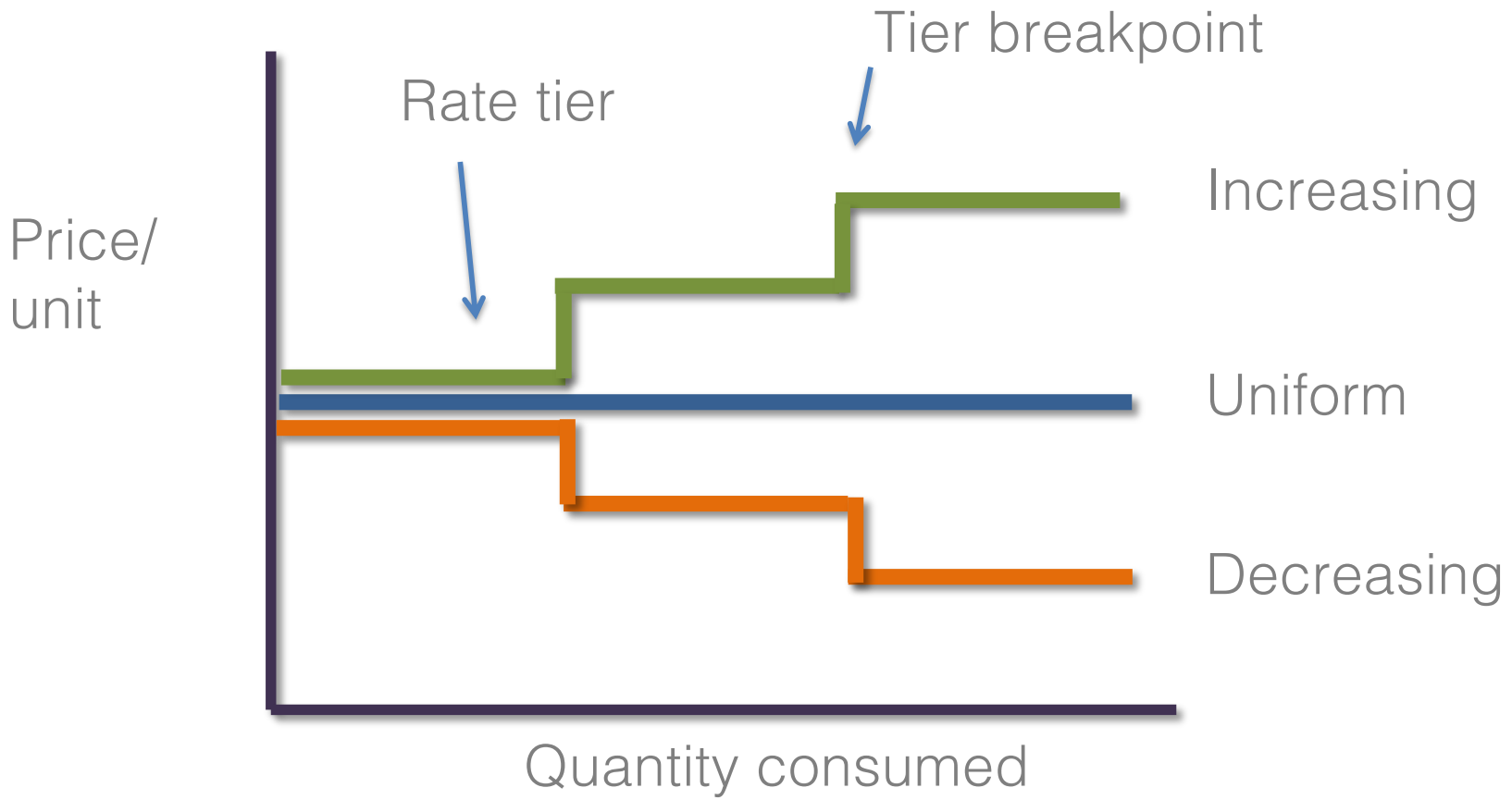
Options identified for Michigan (Detroit and Flint)

- Detroit Blue Ribbon Panel on Water Affordability recommendations
- Flint Interagency Coordinating Committee recommendations

The rationale for customer assistance programs

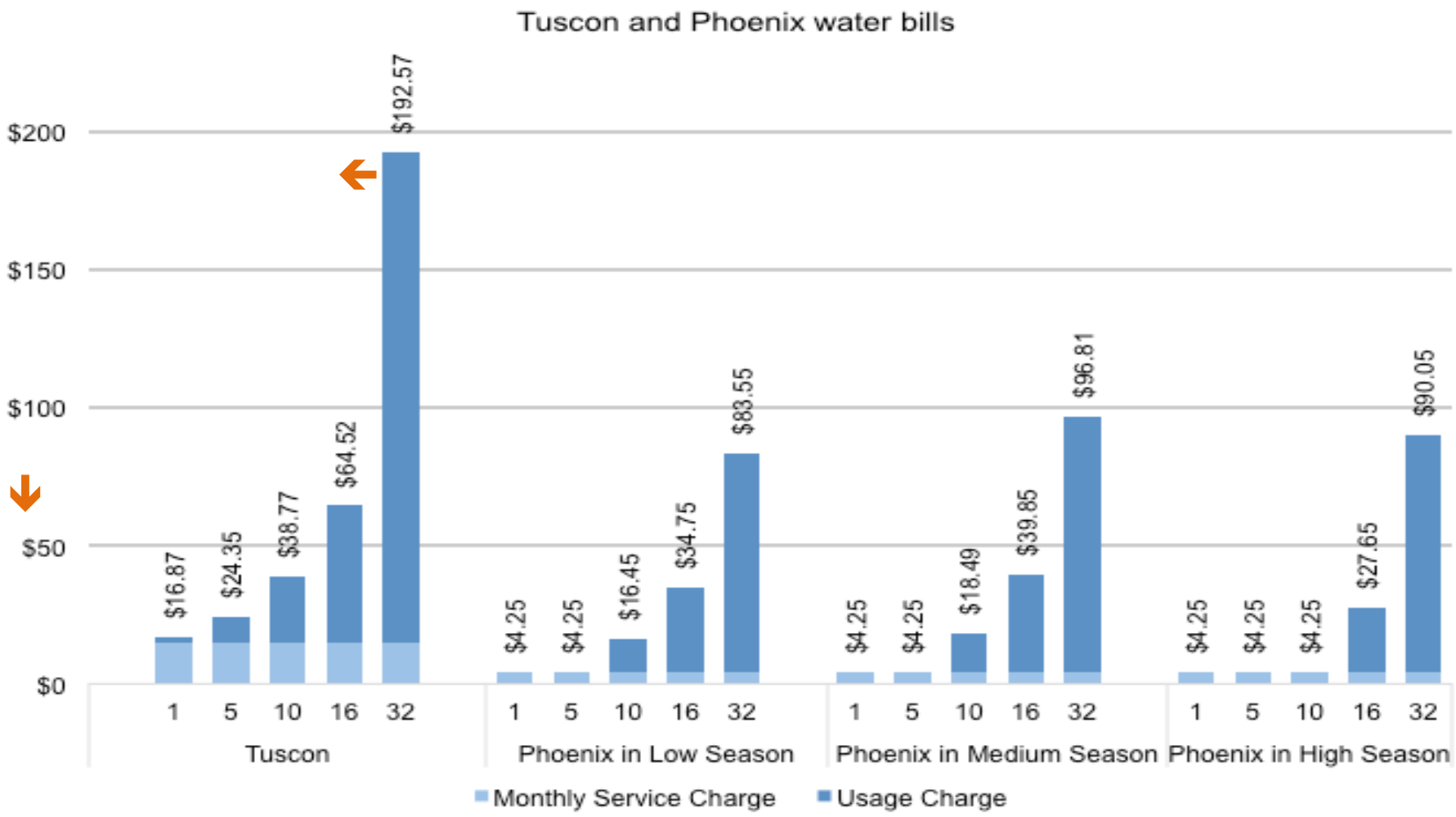
- Utility funded customer assistance programs
  - Emphasize an enterprise model based on full-cost recovery and pricing without subsidy
  - Presume public tax support will be prohibited by law, unavailable, or insufficient
  - Easier for larger systems with a diverse customer base, lower costs, and lower poverty
- Business case
  - “Frequent service shut-offs and resolving bad debt from customers who cannot afford their rates can be more expensive for a utility than instituting a CAP and assisting customers in paying their bills.”
  - “Utilities might use this argument that differences in rates based on income are justified, not only because it is socially responsible but because it helps the utility operate more efficiently.”
  - “The benefit to the utility of having discounts or lower rates for low-income customers is the increased likelihood of collecting payment from these customers; the subsidy makes it possible for these customers to pay more of their bills more regularly and promptly”(Curley 2014)” (Mehan and Gansler, 2017)
- Ratemaking issues
  - Cost recovery from ratepayers is also regressive and will adversely impact the near poor
  - Program audits to ensure proper use of funds and program effectiveness (metrics)
  - Expansion, enhancement, and consolidation of existing programs (i.e., LIHEAP)

Basic rate-design options



Note: rate blocks can be understood like income taxes, that is, rates usually are incremental or marginal and the customer's bill reflects cumulative calculations.

Rate design impact depends on details and perspectives

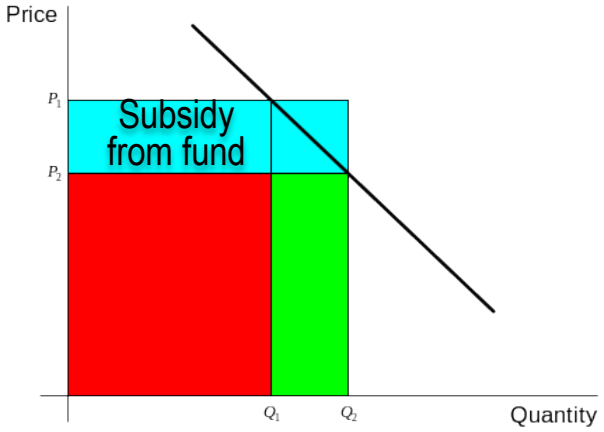


Fixed vs. variable charges: tradeoffs

Recovering more costs from fixed charges	Recovering more costs from variable charges
Static view of infrastructure (more sunk costs)	Dynamic view of infrastructure (less sunk costs)
Enhances revenue stability (less sales revenue risk to utility)	Reduces revenue stability (more sales revenue risk to utility)
Weakens price signals (less resource efficiency)	Strengthens price signals (more resource efficiency)
Familiar & understandable but less acceptable (more predictable and less controllable)	Familiar & understandable but more acceptable (less predictable and more controllable)
Less affordable for low-income households (more regressive)	More affordable for low-income households (less regressive)
Encourages self supply and grid defection (may raise some costs)	Preserves grid supply and participation (may lower some costs)
Possible advantage for combined households (one fixed customer charge)	Possible stability from first blocks (relatively inelastic usage)

Pricing to promote universal access and affordability

- Pricing and affordability
  - First usage block is highly price-inelastic: use standards, programs, assistance, lifelines
  - Additional blocks of usage are price-elastic: set prices to encourage efficiency
- Lifeline rates
  - Limited by policies and practices related to price discrimination and subsidies
  - Programmatic discounts to qualified customers (low-income, seniors)
  - Low-priced first block, sometimes including a quantity allowance
- Income-based rates and rates based on household size
  - Does not comport with legal and practice frameworks (discrimination not based on cost)
  - Intuitive but complicated and expensive to administer and not necessarily equitable



Water usage by income level

- Income and water usage
  - Low income does not always mean low usage
  - However, low-income customers are unlikely to drive peak demand and related costs (e.g., multi-family housing)
  - Low-income customers can be price sensitive, even for essential usage
- Issues with income-based water rates (e.g., Philadelphia)

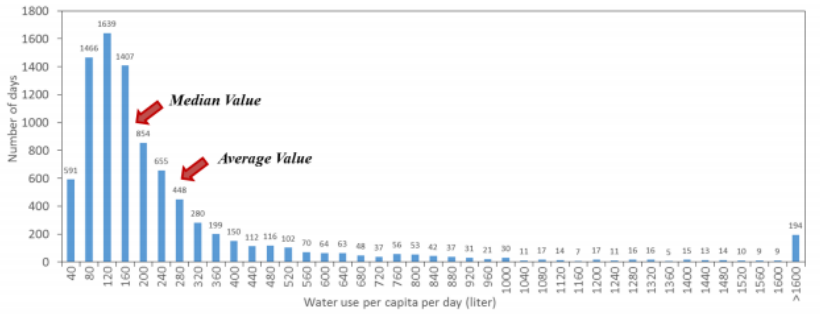


Fig. 8 Frequency distribution of DWU among 50 houses

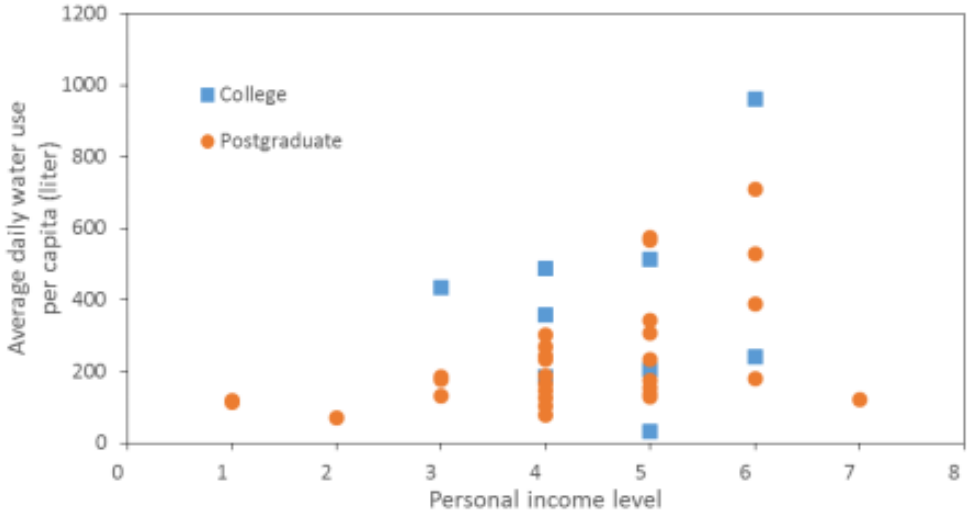


Fig. 7 Average DWU *per capita* with personal income and education

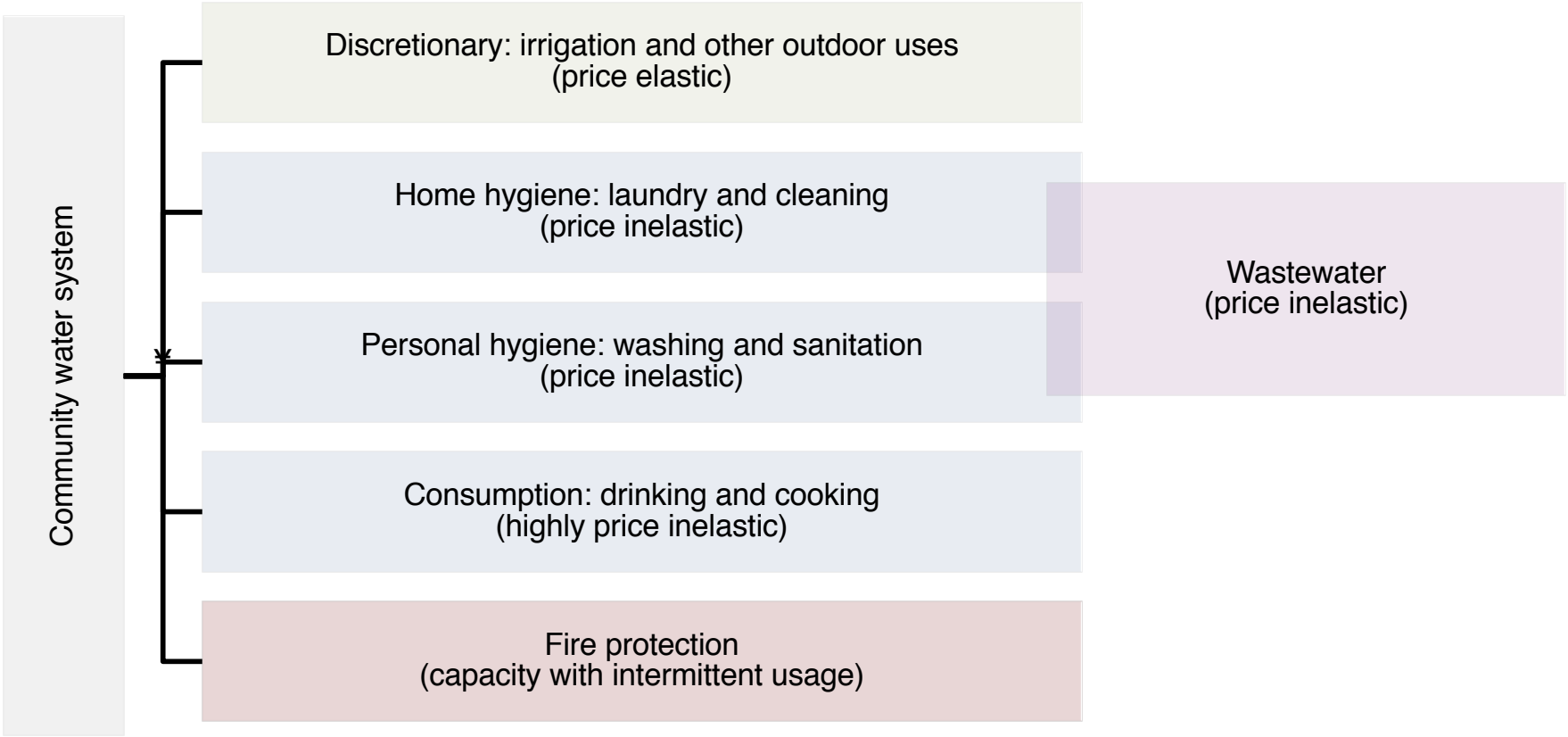
Source: LBL (2017).

Why not income-based rates?

- Communities should have discretion to design their rates and address equity
  - Income-based and “lifeline” rates have intuitive appeal – e.g., Philadelphia Water Dept.
- Implementation issues
  - Depart from prevailing legal and practice frameworks (cost-based pricing, efficiency)
  - Resistance from consultants, utilities, ratepayers, regulators, politicians
  - Subject to legal challenge based on undue discrimination (based on cost of service)
  - Complicated and expensive to administer and consumer privacy issues (income data)
  - Income is an imperfect measure – can be distorted, gamed, and does not reflect wealth
  - Averages and medians for costs and income mask wide variations
  - Thresholds are arbitrary and imperfect at any level (e.g., 2%)
  - Price signals remain relevant for discretionary water usage
- An inclusive progressive rate structure can ensure affordability for essential use
  - Can be reconciled with cost-of-service principles
  - Lower cost of implementation and less distortion
  - May be perceived as more fair and equitable (vs. “targeting”)
- Considering household size in rate design
  - Household size raises issues of choice affecting cost of service
  - Assistance programs take both income and children into account
  - Also imperfect and administratively complicated
  - Utilities can also provide medical exceptions

Water systems: five products, one set of pipes

- Water systems are service "co-generators" of differentiated products
  - Essential water usage is nondiscretionary – consumer agency is limited and usage is not conducive to price signals (demand response)
  - Water and wastewater services are symbiotic and often bundled – but uncritically
  - Wastewater is price inelastic and a byproduct and resource – water, energy, nutrients



Public fire protection costs (Wisconsin study)

Figure 10. Public Service Commission Cost-of-Service Model

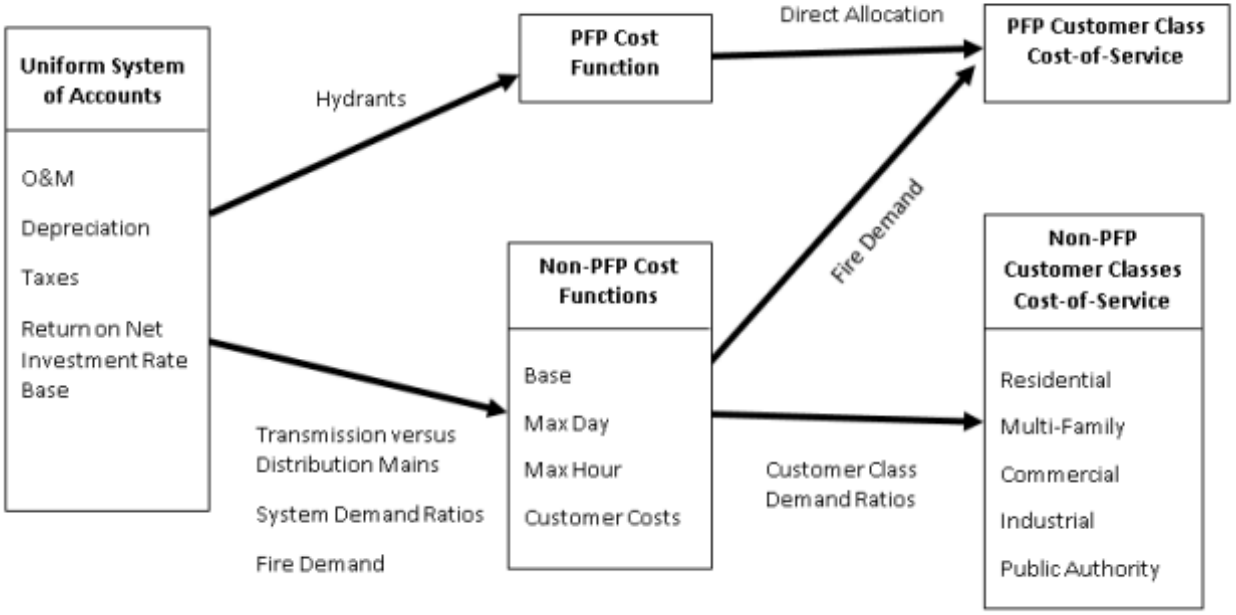
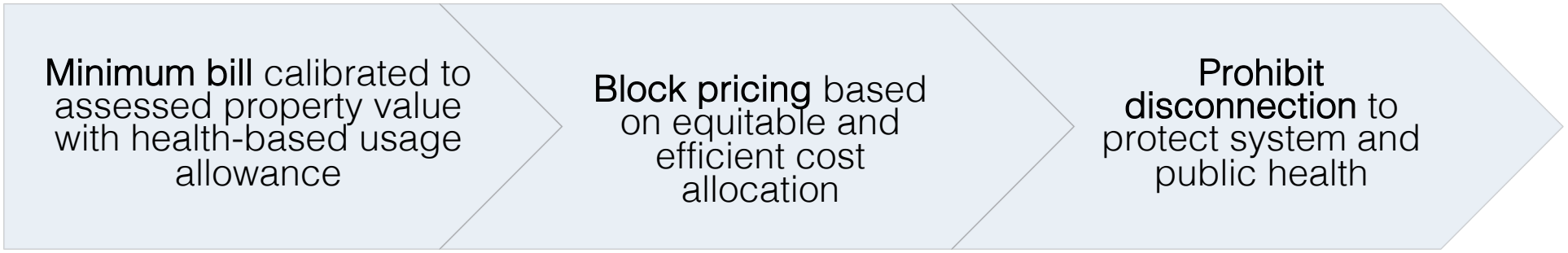


Table 3. Average PFP Cost-of-Service as a Percentage of Total Cost-of-Service (n=218)

Utility Class	Averge PFP Cost-of-Service as Percentage of Total Cost-of-Service
AB	18%
C	29%
D	34%

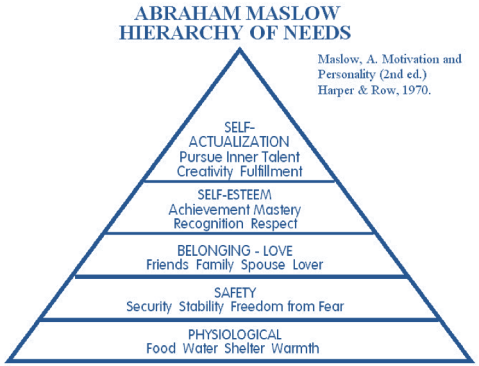
A new paradigm: universal equity-efficiency rate (Beecher)

- Moving beyond conventional economics dogma of ratemaking
  - Which presumes utility model and full-cost pricing
  - Limits in water and perhaps more so in wastewater and stormwater
- Universal, principled, and defensible
  - Applicable to all water customers – satisfying intraclass equity concerns
  - May become more relevant for network-intensive industries
  - Theoretical, practical, and normative support – possible stakeholder appeal

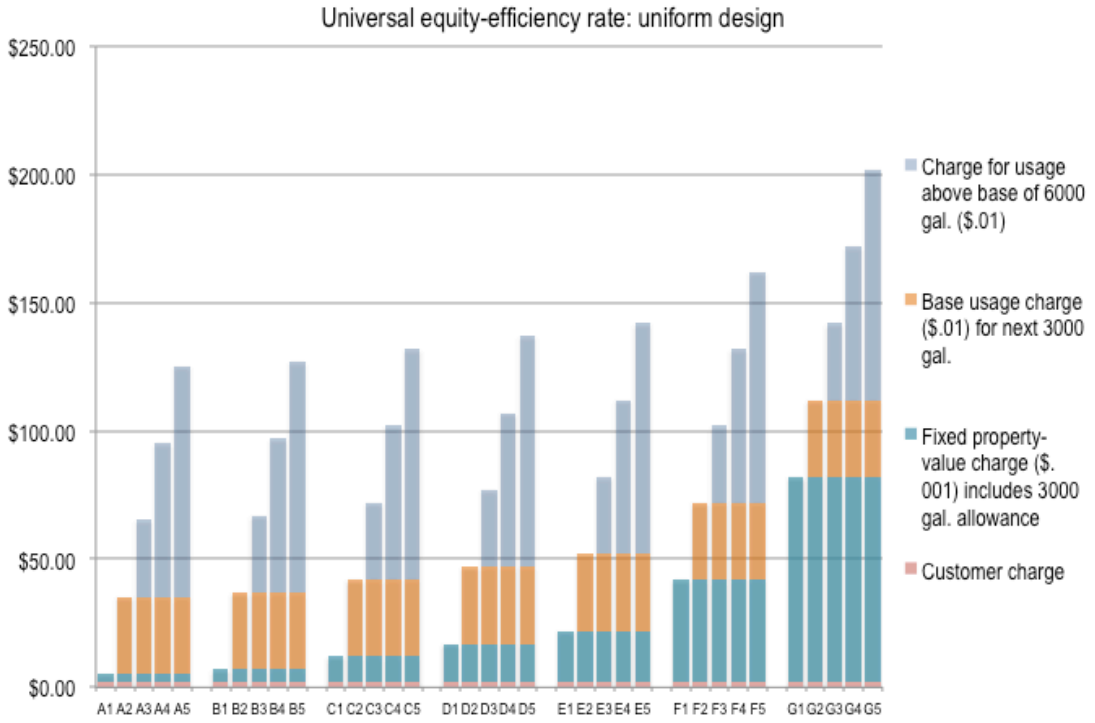


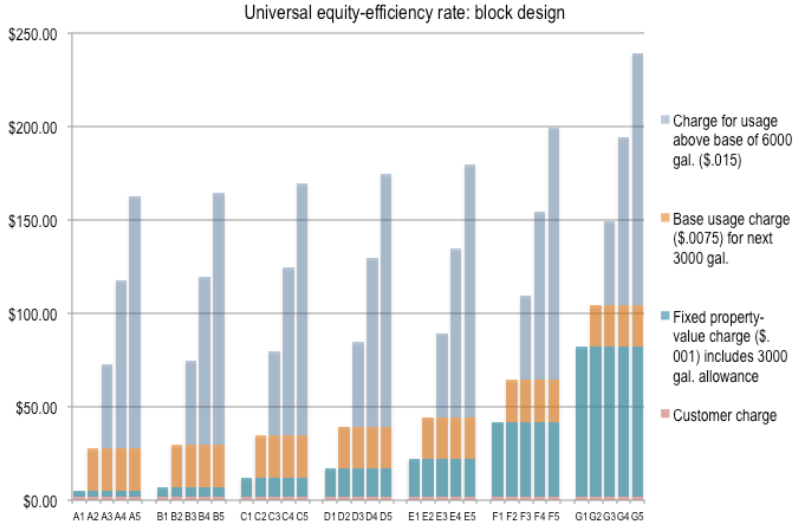
A new paradigm: universal equity-efficiency rate (Beecher)

- Minimum bill calibrated to assessed property value
  - Constitutes a demand-correlated network capacity charge
  - Includes an essential usage allowance for all households and should be tax-exempt
  - Works best with systems of scale and additional assistance may still be needed
- Block pricing based on equitable and efficient cost allocation
  - First: essential usage based on public health criteria (included in minimum bill)
  - Second: basic usage priced with a uniform volumetric rate
  - Third: discretionary usage priced for efficiency based on marginal cost
- Prohibit (ban) service disconnection consistent with the human right to water
  - Would focus the policy mind – as has been lacking in this area
  - Disconnection is not good business, governmental, or social practice
  - Unlikely to reduce (may raise) system cost of service – *not cost based*



Universal equity-efficiency rate (Beecher)



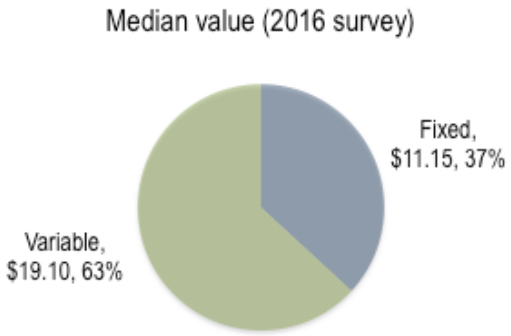


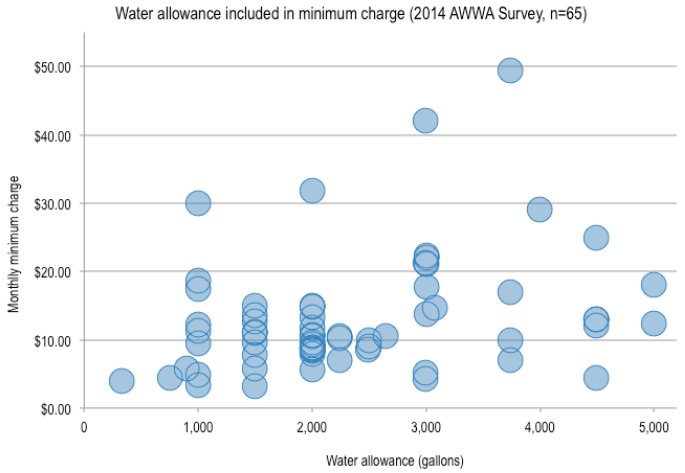
Rationale for a new paradigm

- Theoretical rationale
  - Reconciles theory and conceptions of efficiency & equity (intra/inter-class cost of service)
  - Consistent with full-cost recovery and enterprise model for utilities
  - Associates property value, equivalent units, income, wealth, and water needs and usage
  - Provides mechanism for supporting network capacity (demand) in falling usage context
  - Maintains economic price signals for discretionary usage (where they matter)
  - Recognizes value of public fire protection and non-allocable cost (based on usage)
  - Added theoretical support: insurance, taxation, social-good, historical pricing models
- Practical rationale
  - Co-benefits of “base” capacity for system health, public health, fire protection
  - Mitigates effects of rising costs and declining usage on low-income & low-volume users
  - Cost-effectiveness and implementation ease (vs. disconnection, income-based rates)
  - Provides rate and revenue stability to maintain the distribution network and credit quality
  - Makes use of tax information but is still a user fee and not a tax
  - Adaptable as to details (allowance based on household size, block pricing, prepayment)
  - Potential transferability to wastewater, stormwater, energy
- Normative rationale
  - Consistent with broad principles of equity and fairness in cost allocation, as well as the social value of service and the ability of the social unit to support infrastructure costs
  - Human right to water and sanitation (security), protection of innocents (children), and affordability as a public health issue
  - Not just a business case for compassion – but a compassion case for compassion
  - Possible alternative to concept of university basic income

Usage allowance

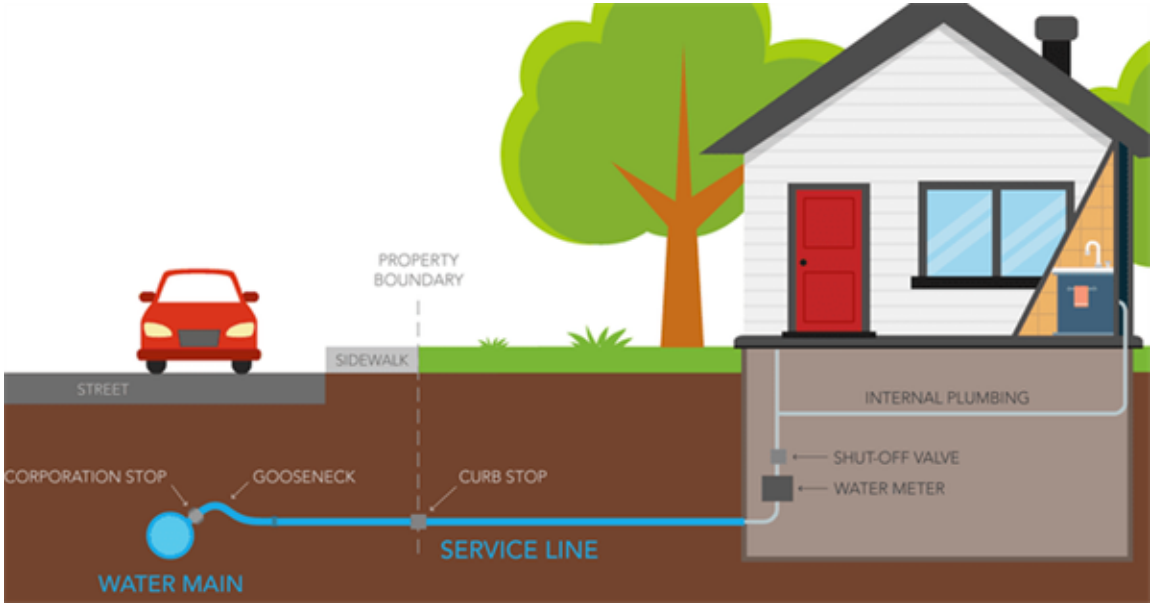
- Inclusion of a usage allowance in a fixed tax-exempt minimum bill
  - Useful in satisfying preference for universal equity (fairness)
  - Avoids differentiated (discriminatory) service levels and associated inequity
  - Distorts end-use efficiency incentives only if usage is discretionary
  - May be more appropriate for water given storability, renewability, and externalities
- World Health Organization recommendations for water
  - Minimal provision of 50-100 liters per person per day for human health (indoor usage)
  - Consider default at 25 gpcd (100 liters) or about 3,000 gal. per household per month
  - Indoor household usage in the U.S. varies but generally exceeds this amount
- Timely metered consumption data would facilitate self-rationing





Service limiter (flow restriction) instead of disconnection

- Disconnection is inhumane and punitive, with potentially severe externalities
- Service (flow) limiter instead of disconnection (shutoff)
  - Flow, volume, or time-limiting (tamper-proof valves, meters)
  - Comparable to voltage limiter in electricity



Utility services as human rights

- Is affordable access a basic human right?
  - Life, liberty, and the pursuit of happiness
  - Equal protection under the law
  - Security of person
  - Freedom from want
  - Dignified existence
  - Social inclusion
- Environmental justice
  - Economic and racial dimensions
  - Incarcerated individuals
- Sector differences
  - Water for drinking – right to compliance vs. service
  - Energy – heating and cooling
  - Broadband communications
- Intractable nature of poverty and inequality
  - Policy roles and challenges
- Universality means connecting all who want service
  - End disconnection as a motive and measure of success