Municipal Water Pricing: Issues & Roles in California

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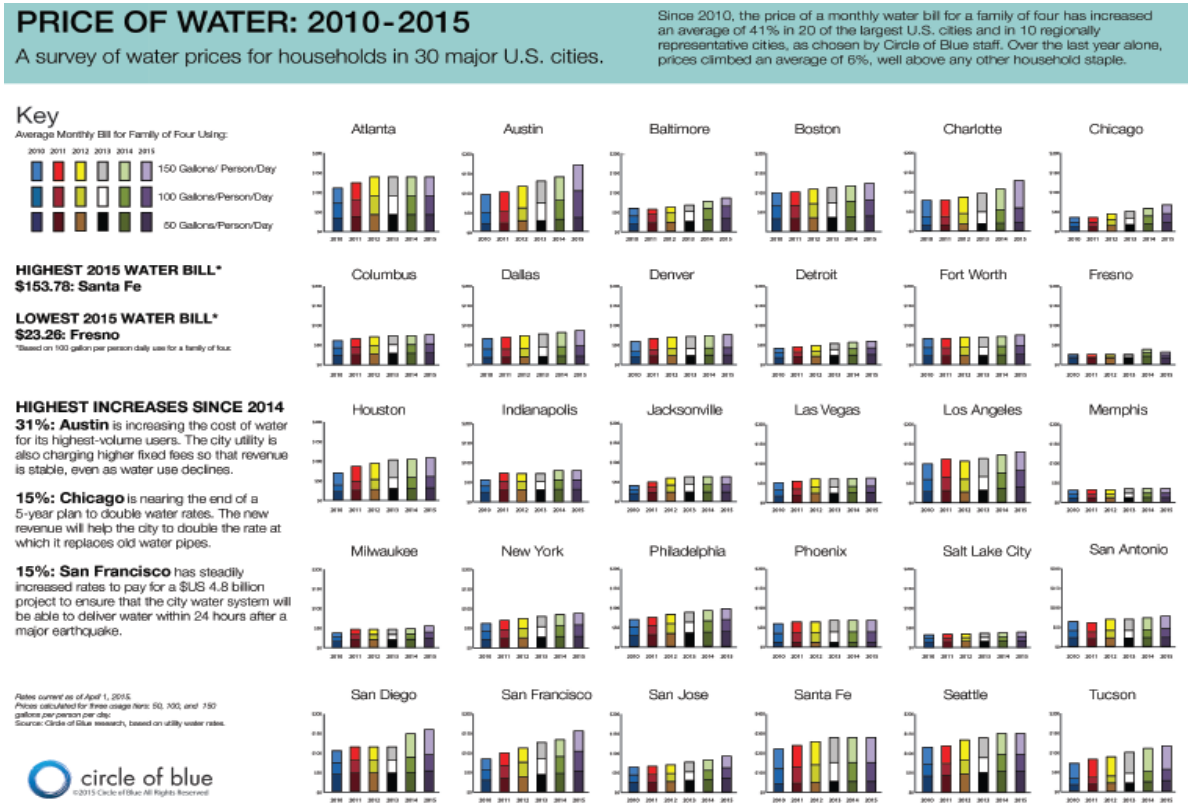
CALIFORNIA OFFICIALS DRAFT A $600M PLAN TO HELP LOW-INCOME HOUSEHOLDS ABSORB RISING WATER BILLS

WESTERN WATER NOTEBOOK: STATE WATER BOARD REPORT PROPOSES NEW TAXES ON PERSONAL AND BUSINESS INCOME OR FEES ON BOTTLED WATER AND BOOZE TO FUND RATE RELIEF PROGRAM



Lafond, K. Infograhic. Circle of Blue, accessed 2/18/19

MWD (1990): 208 gpcd
MWD (2013): 175 gpcd
Urban GPCD elsewhere…
Israel: 84
Spain: 76
Australia: 80 to 130
(Hanak et al. 2011)

Objectives / Outline

- Discuss 3 (of many) current challenges confronting municipal water agencies
- Highlight strengths and weaknesses of different municipal water pricing structures in meeting different objectives
- Illustrate how budget-based (allocation based) increasing block rate pricing has worked in two water districts
- Identify challenges and possible reforms that confront California in consideration of municipal water pricing

Three (of many) Challenges Confronting Water Agencies

1. Upgrading Water Infrastructure
   - Usually agency funded
   - Outdated and dilapidated

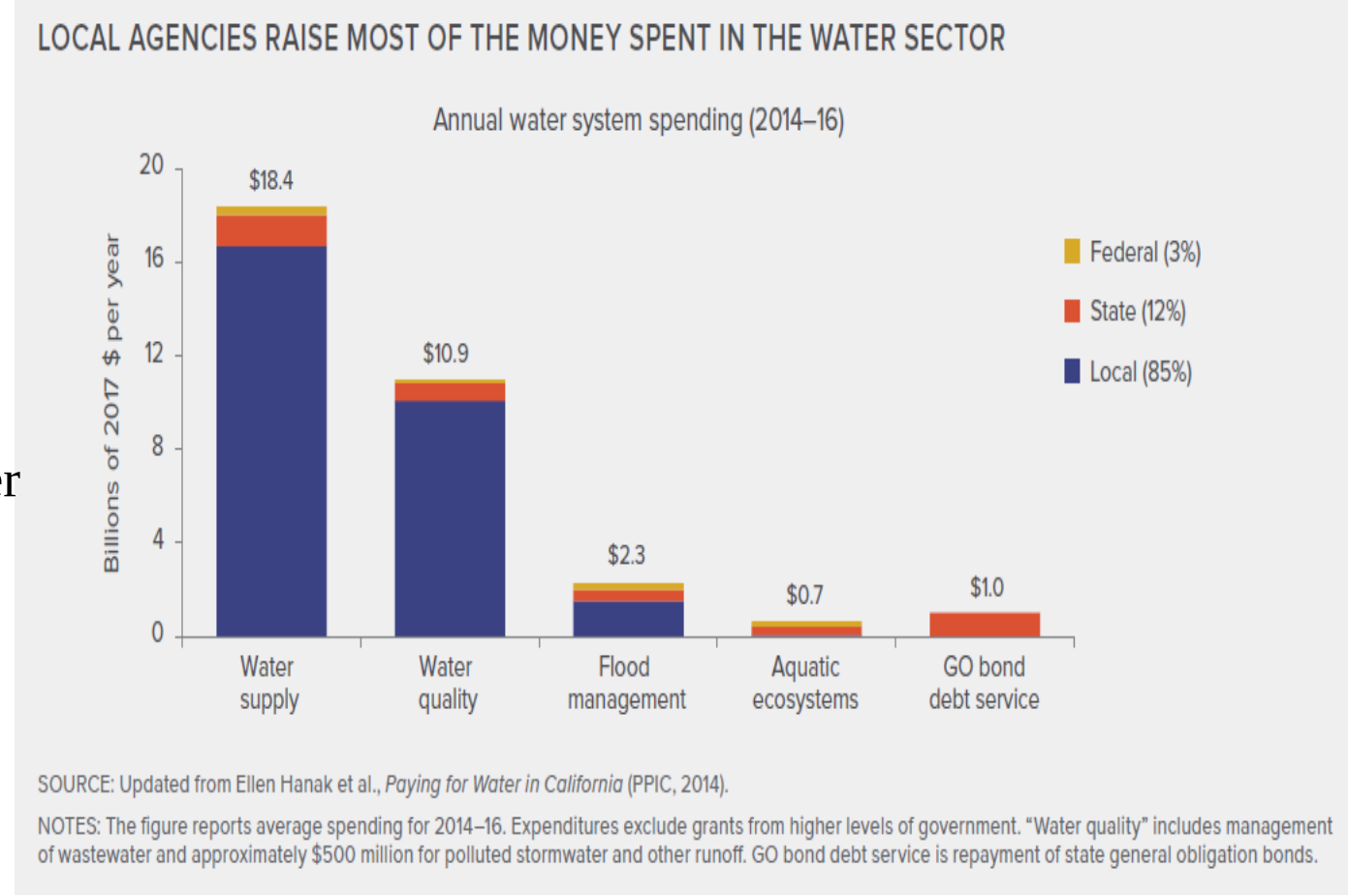
2. Confronting Water Scarcity
   - Long term scarcity from rising populations and climate change
   - Short term shortfalls from more frequent and intense drought

3. Addressing Water Affordability
   - Rising water prices
   - Human right to water

Upgrading Aging Water Infrastructure (PPIC 2019)

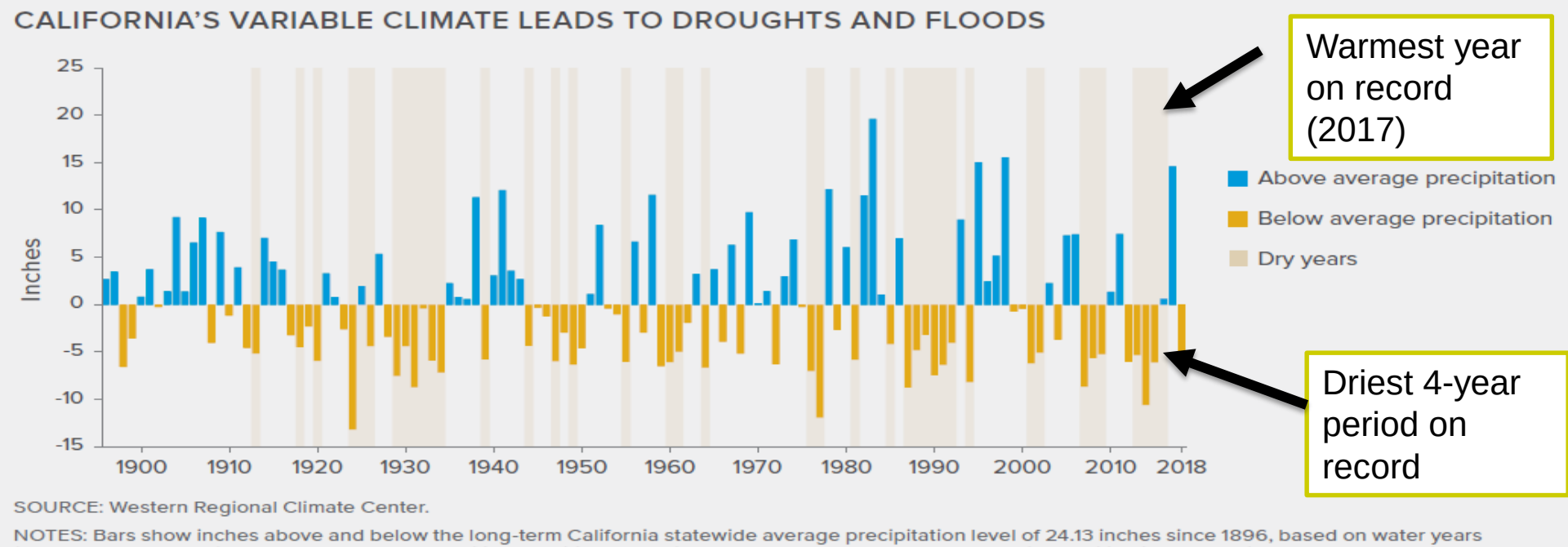
1. Local Agencies generate > $30 billion annually (85% costs are fixed!)
   - Larger agencies faired particularly well in general through investments
   - …but rising water prices to pay for investments are more and more challenging

2. Still confront funding gap for particular areas:
   - ½ of dams > 50 years old
   - Wastewater reuse
   - Conservation
   - Safe drinking water to poor communities
   - flood control
   - stormwater management
   - ecosystem health



Rising water scarcity

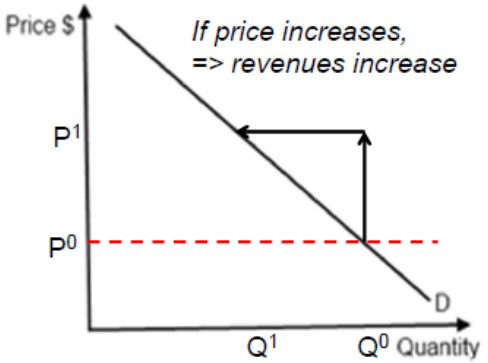
- Population growth CA (39 to 60 million by 2060)
- Increased demand for environmental quality
- Warmer climate / Less snowfall
- More frequent and intense drought



Addressing Scarcity through Demand-side Management

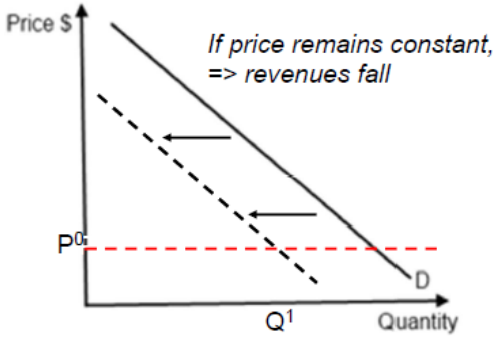
Definition of ***Scarcity:*** Degree to which demand exceeds supply at a given price

Two Approaches to Demand-side Management to reduce water use (demand)



A. Price-based approaches (e.g., volumetric pricing)
   - Alter behavior through changes in relative prices

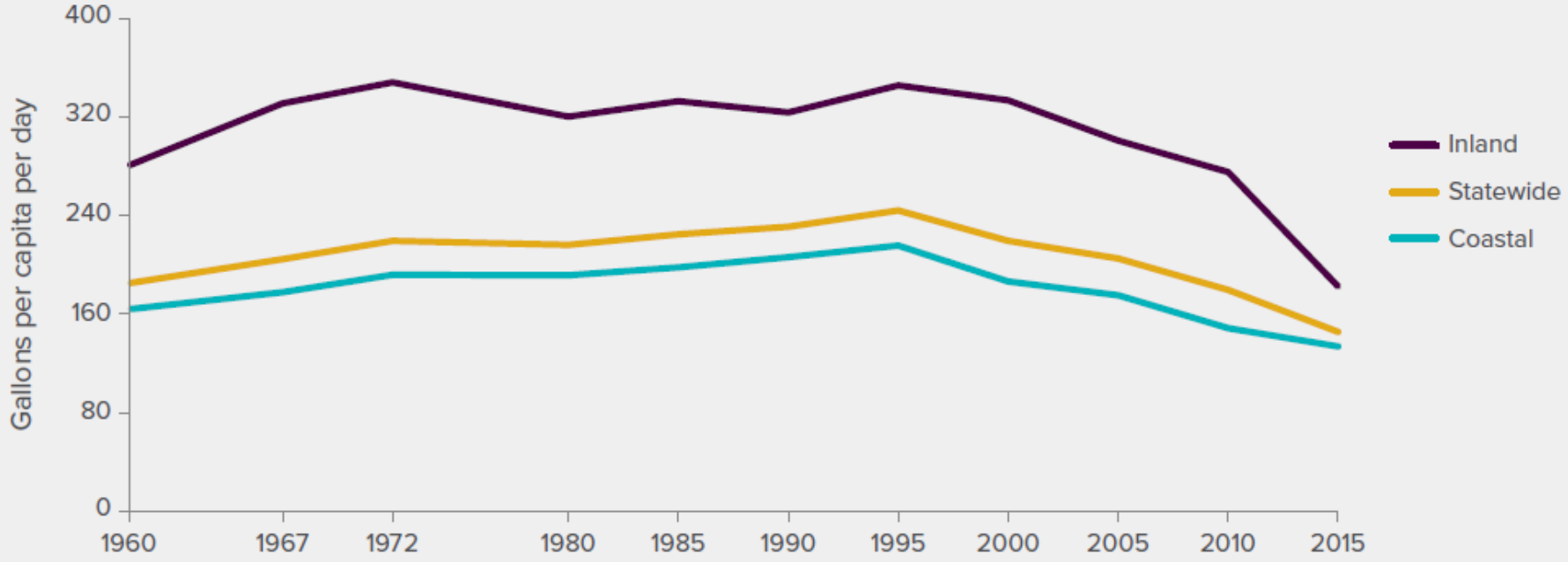
B. Nonprice-based approaches (directly & indirectly alter behavior)
   - Technological adoption (often with rebates)
     - *Often motivated by env. attitudes rather than cost savings*
   - Voluntary appeals, mandatory restrictions, info & education
     - e.g., Moral suasion



Effects of Water Efficiency / Conservation Programs (PPIC 2019)

- 1995-2010: 27% reduction in per capita water use (244 down to 178 gpcd)
- 2013-2105: 25% reduction in per capita water use (173 down to 130 gpcd)

PER CAPITA URBAN WATER USE HAS BEEN FALLING AND FELL STEEPLY DURING THE LATEST DROUGHT



SOURCE: Author calculations using data from the California Department of Water Resources, *California Water Plan Update* (various years).

NOTES: The figure shows "applied" water delivered to homes and businesses. "Net" water use—i.e., the volume consumed by people or plants, embodied in manufactured goods, evaporated, or discharged to saline waters—is lower. The totals exclude water used by power plants and groundwater recharge projects and water lost during conveyance. Except for 2015 (a severe drought year), the estimates are for normal or "normalized" rainfall years (i.e., adjusted to levels that would have been used in a year of normal rainfall). Estimates are for water years (October to September). Inland areas tend to have higher per capita use because of higher temperatures and larger landscaped areas.

Water Conservation: Prices vs. All Comers…

How do price-based measures compared to other approaches?

- Timmons (2003). Compared mandatory low-flow appliance regulation vs modest water price increase using data from 13 groundwater dependent California cities
  - ***Prices almost always more cost-effective than technology standards***
- Brennan et al. (2007). Studied sprinkler restrictions in Perth, Australia
  - ***Restrictions on use of sprinklers leads to more overwatering from hand-held hoses resulting in little water savings but additional costs***
- Grafton and Ward (2008). Compare effectiveness of mandatory restrictions to water prices in Sydney, Australia
  - ***Find that mandatory water restrictions result in costly and inefficient responses relative to prices***

Water Conservation: Prices vs. All Comers…

- Ample evidence customers respond to price changes and it is a cost-effective means of achieving conservation goals

- Pricing provides revenue needed to cover operating costs and utilizes an existing monitoring system (water meters)

  => Demand is "inelastic" => price increases decrease demand yet raise revenues

- However…evidence pricing tends to be regressive:

  => it has a disproportionate impact on lower-income households.

Water Affordability

Often considered as fraction of income:

Affordability Index = f (water expenditures / income)

where: water expenditures = (***price****consumption)+other costs

Some significant issues:

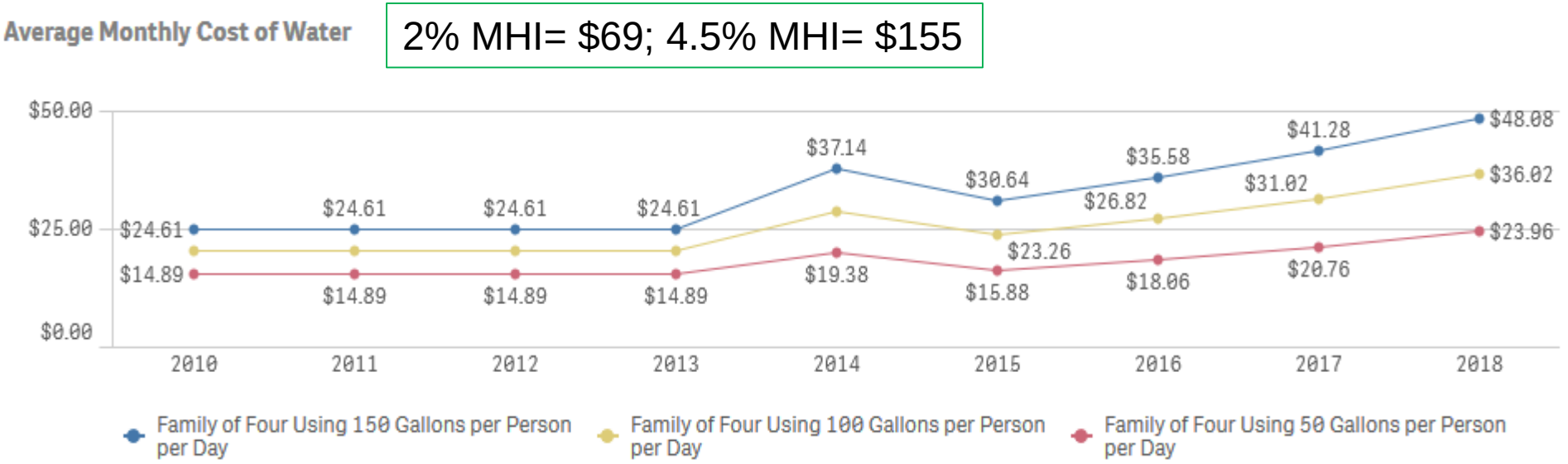
- Appropriate definition of consumption, expenditures, other costs for the purpose of defining "affordability"
- Income or wealth or disposable income after accounting for other expenses

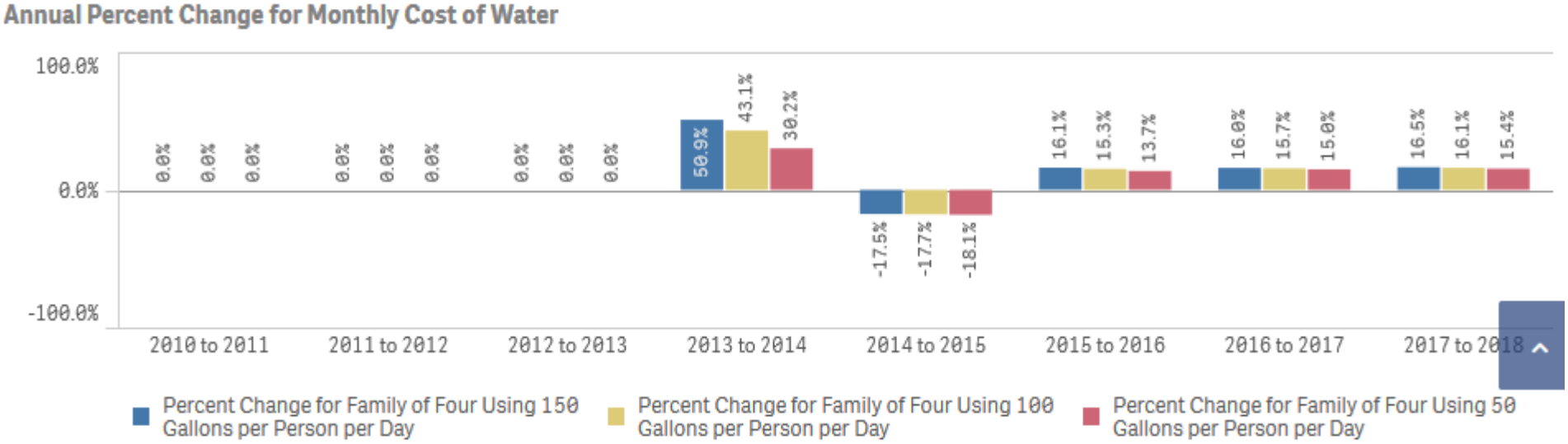
Commonly used Assumptions:

- Minimum basic human needs: 13 to 35 gpcd (Gleick 1996)
- Unaffordable (US EPA / US Council of Mayors 2014):
  - Water expenditures > 2% of median household income
  - Water and Sewage expenditures > 4.5% of median household income
  - CA (30 city sample): Median monthly total water cost = $98
    - Spent $12 million annually in excess of 4.5% threshold
    - Lower income households disproportionately exceeded 4.5% threshold

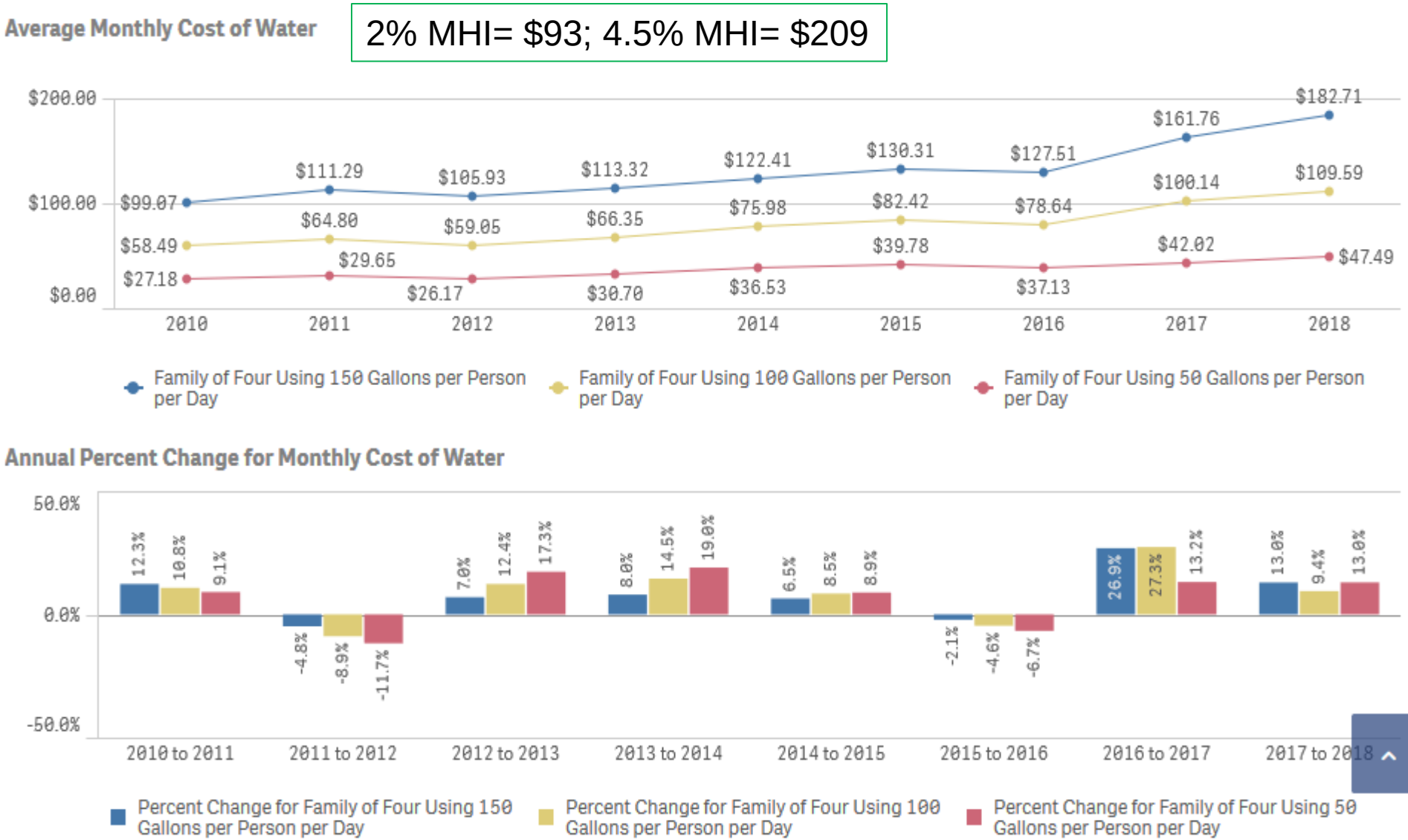
Monthly Water Costs: Fresno (Circle of Blue 2019)

2% MHI= $69; 4.5% MHI= $155





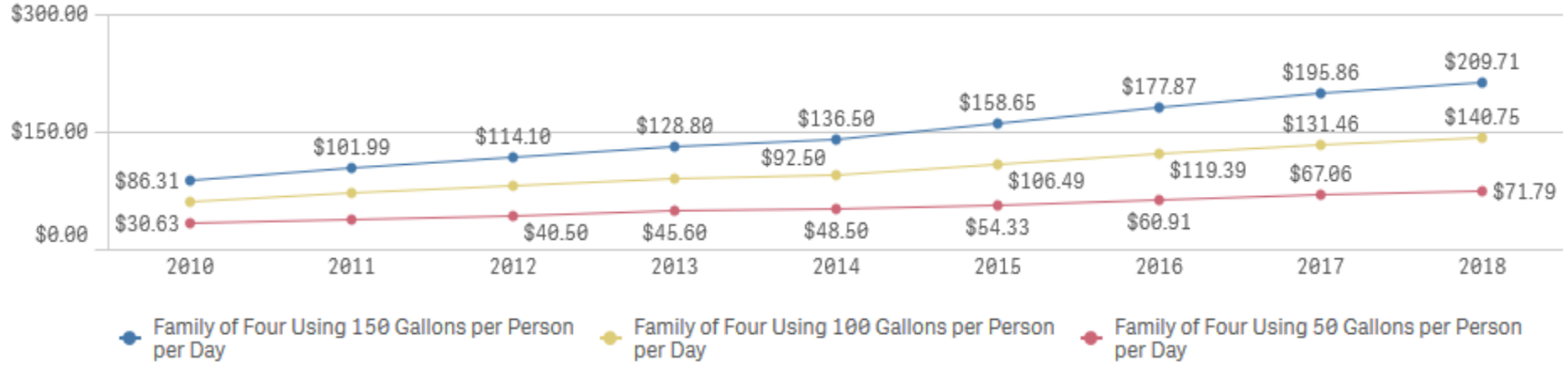
Monthly Water Costs: Los Angeles (Circle of Blue 2019)



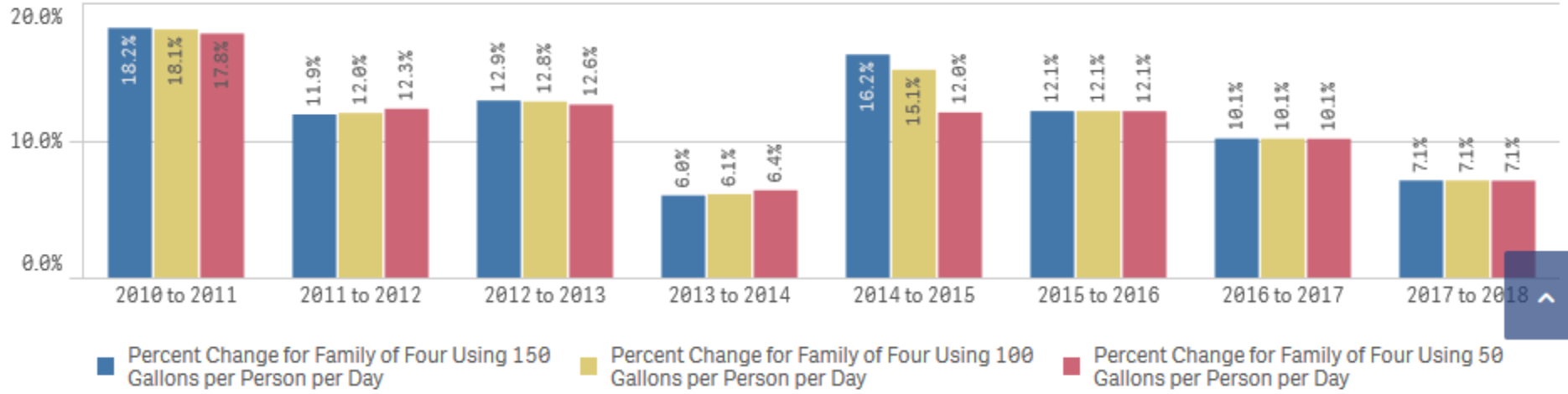
Monthly Water Costs: San Francisco (Circle of Blue 2019)

Average Monthly Cost of Water

2% MHI= $160; 4.5% MHI= $361



Annual Percent Change for Monthly Cost of Water



Water Affordability

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Consider…

- Average CA household paying 45% more for water in 2015 than 2007
- Low income households get help for phone, natural gas, and electric bills
- $600 million is estimated cost in first year
- Possible assistance/mechanism for low-income households:
  - Bills < $90/month => 20% benefit
  - Bills > $90 but < $120 => 35% benefit
  - Bills > $150 => 50% benefit

How should water be priced?*

- Common goals of a water price structure:
  - Financial stability: maintain a balanced budget
  - Equity: ensure affordability for essential uses
  - Efficiency: send an appropriate marginal cost signal
  - Hall (2009) adds…Political feasibility (LA DWP rate structure designed by Hall, Hanemann, etc. in 1993)
  - Griffin (2006) adds "Simplicity and Transparency"
- Challenges to finding an appropriate price structure:
  - Efficiency typically requires a higher price
  - Equity typically requires a lower price
  - Neither is likely to achieve a balanced budget without some other adjustments

* w/ K. Baerenklau

Alternative water rate structures

- *Flat rate*: a fixed charge per billing period
  - Doesn't encourage conservation
- *Uniform rate*: a constant price per unit consumed
  - Doesn't recognize that how the value of water decreases as more is consume
- *Block rate*: price per unit depends on amount consumed
  - Recognizes value decreases with use – encourages conservation -- but poor at recognizing differences in uses and users
- *Allocation- (or budget-) based rate*: blocks depend on household and environmental characteristics
  - Recognizes differences in users and values…challenging based on current regulatory framework

Water pricing in California

- 2005: ~50% of all utilities (400+) using block rates
- 2008: < 14 utilities were using allocation-based rates (water budgets)
- 2009-2018: 14 more utilities adopted allocation-based rates (all in southern California)
  - Major drivers:
    - (Past) Governor's *20x2020 Water Conservation Plan*
    - (Now) ***SB 606 / AB 1668 – specify new efficiency standards and use of water-budget based methods for quantifying water district objectives***
- Why the apparent reluctance to adopt allocation-based rates?
  - Fixed cost
  - Financial risk
  - Legal questions (more on this later…)
  - ***Uncertain effect on demand***: is it worth the cost/risk?

From Ash, T. (2019)

WBR Implementations:

IRWD (1991)
Highlands Ranch, Co. (2004)
Castle Rock, Co. (2005)
Boulder, Co. (2007)
Palmdale WD, (2008)
Coachella Valley WD (2008)
Eastern Municipal WD, (2009)
City of Corona (2009)
Rancho California WD (2010)
Elsinore Valley MWD (2010)
El Toro WD (2010)
Moulton Niguel WD (2011)
Western Municipal WD (2011)
Las Virgenes WD (2015)
Santa Margarita WD (2017)
5 agencies in SAWPA region

Allocation Based Rates Example: EMWD

Eastern Municipal Water District (EMWD) switched from uniform rates to increasing block allocation-based rates in April 2009:

- *Indoor* water use: $w_1 = (HHS \times PPA) \times DF + IV$
- *Outdoor* water use: $w_2 = (ET \times CF \times IA + OV) \times DF$
- *Excessive* water use: $w_3 = \frac{1}{2}(w_1 + w_2)$
- *Wasteful* water use: in excess of w_3

"Water budget"

Goal was to promote conservation while maintaining fiscal balance

→ *How much conservation did they achieve?*

→ *Similar question for MNWD, although they had 5 blocks*

Effects of Allocation-Based Pricing on Residential Water Demand

1. Eastern Municipal Water District (EMWD)

Baerenklau, K., Schwabe, K., and Dinar. A. 2014.

"The Residential Water Demand Effect of Increasing Block Rate Water Budgets."

Land Economics (2014)

2. Moulton Niguel Water District (MNWD)

Schwabe, K. and Baerenklau, K. 2016.

Phase I Report submitted to MNWD

Funding and data provided by Eastern Municipal Water District (Special thanks to Behrooz Mortazavi, Elizabeth Lovsted, and Kristian Barrett) and Moulton Niguel Water District (Special thanks to Joone Lopez, Drew Atwater, Jonathon Cruz)

Goals of the studies

Answer three questions:

- How have allocation-based rates affected water demand?
- How responsive is water demand to changes in water price?
- How might pricing be used by water agencies to respond to:
  - Population growth?
  - Economic growth?
  - Climate change?

  w/ efficiency, equity, and financial stability concerns in mind

Estimating the demand effect of allocation-based rates (ABR)

- Step I: Collect Relevant Data.
  - Identify major factors influencing household water demand
- Step II: Estimate Uniform Rate Model
  - Estimate a demand model that accounts for these factors using data from before the rate change
- Step III: Predict water usage if Uniform Rates had remained in effect
  - Use the model to predict demand after the rate change
- Step IV: Identify Impact of ABR
  - Difference between actual and predicted demand is the estimated demand effect

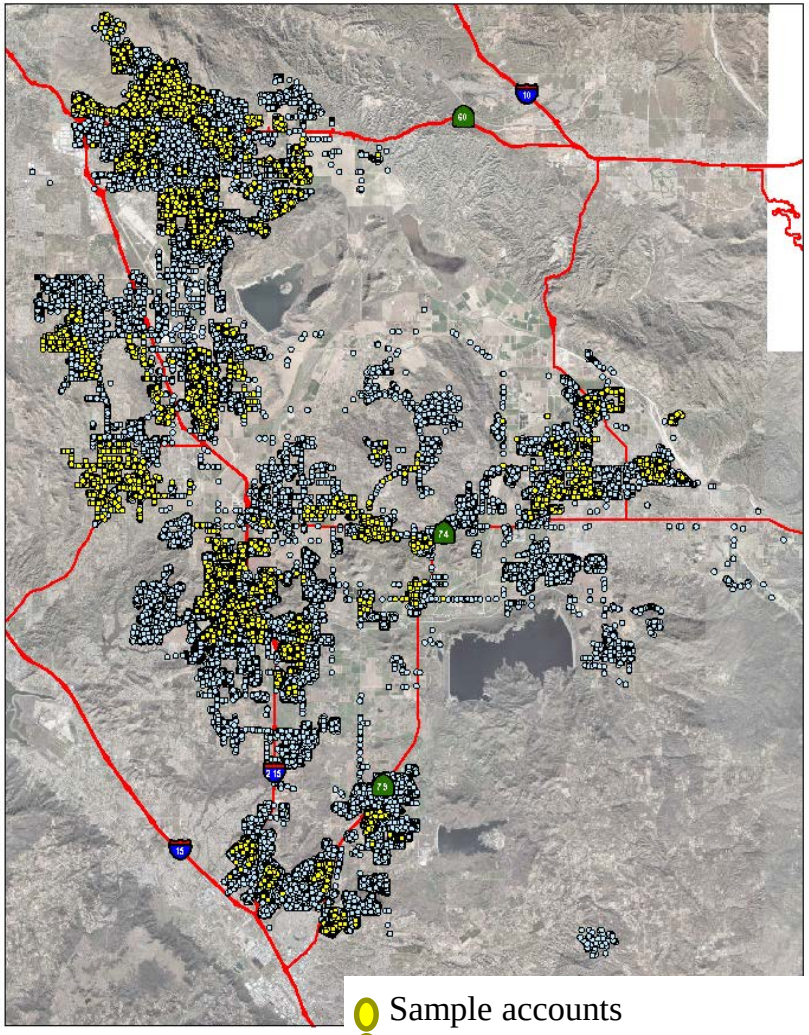
Step I
Data: sources and types

- From EMWD & MNWD
  - Pricing, usage, household size, irrigated area, conservation requests, microclimate zone, latitude/longitude

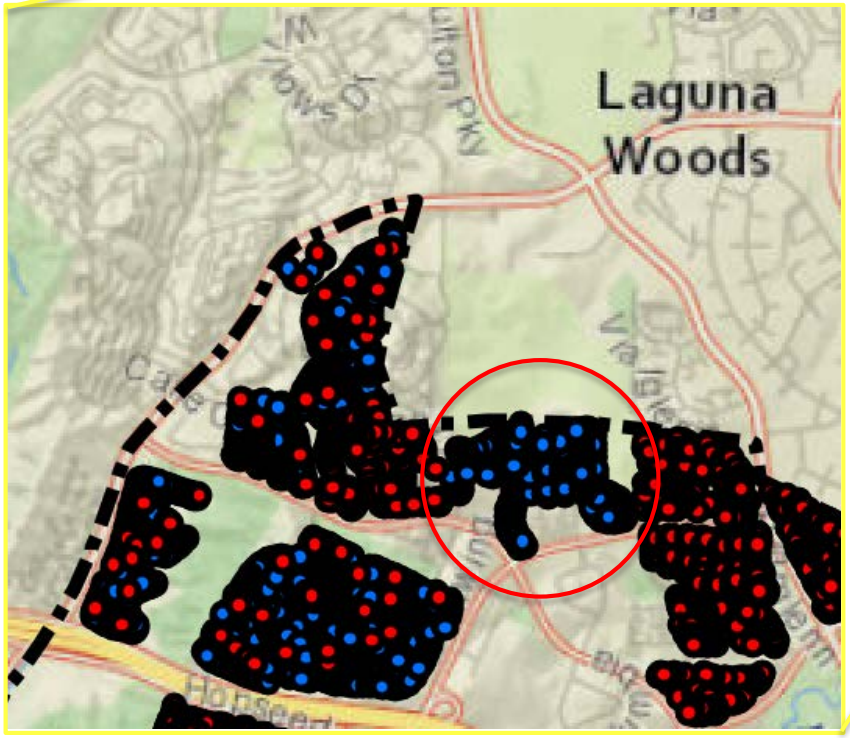
- From other sources:
  - ET: EMWD/Hydropoint, CIMIS
  - Income, education: U.S. Bureaus of Census and Labor Statistics

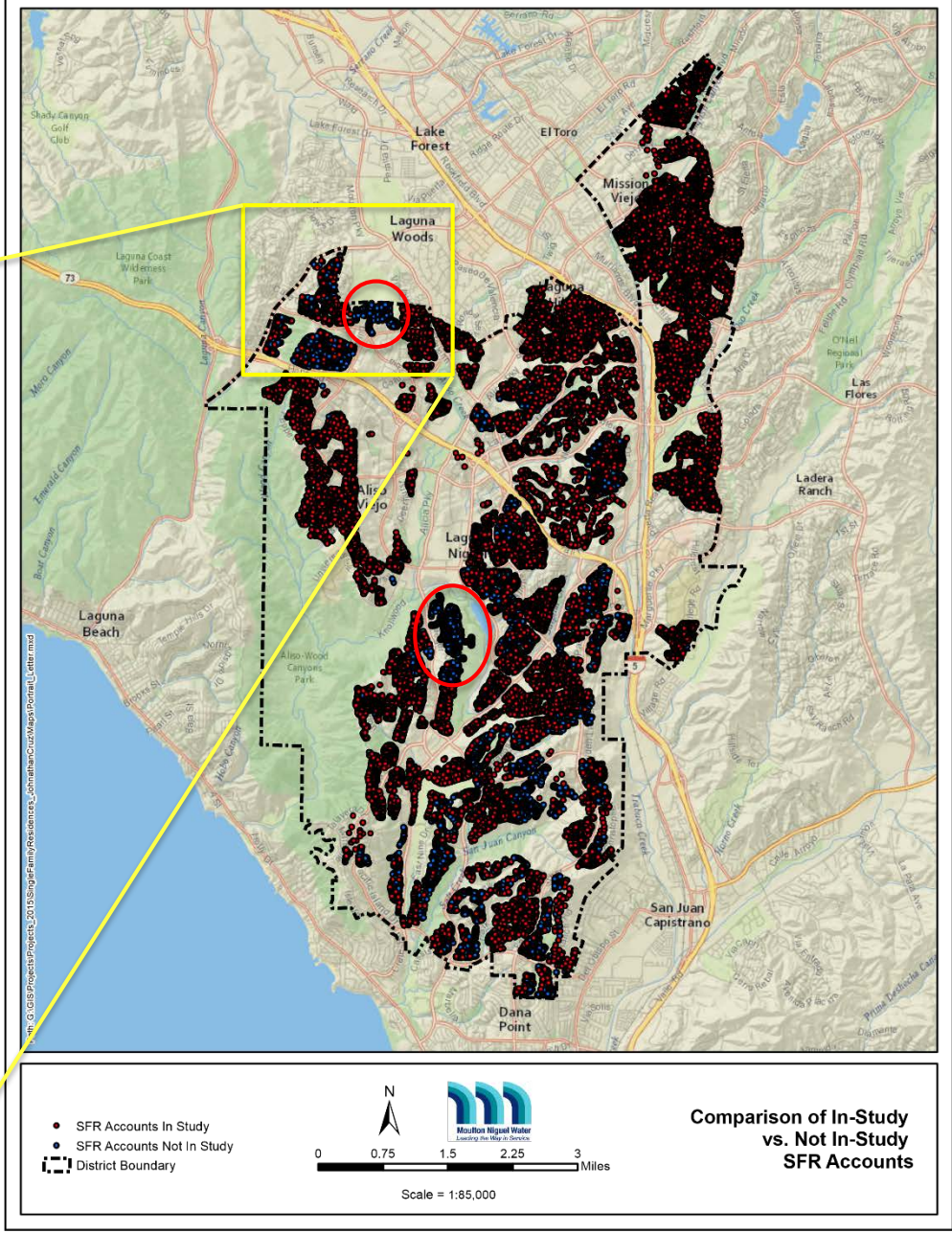
EMWD Service Area

Spatial distribution of sample households



Spatial distribution of sample households: MNWD





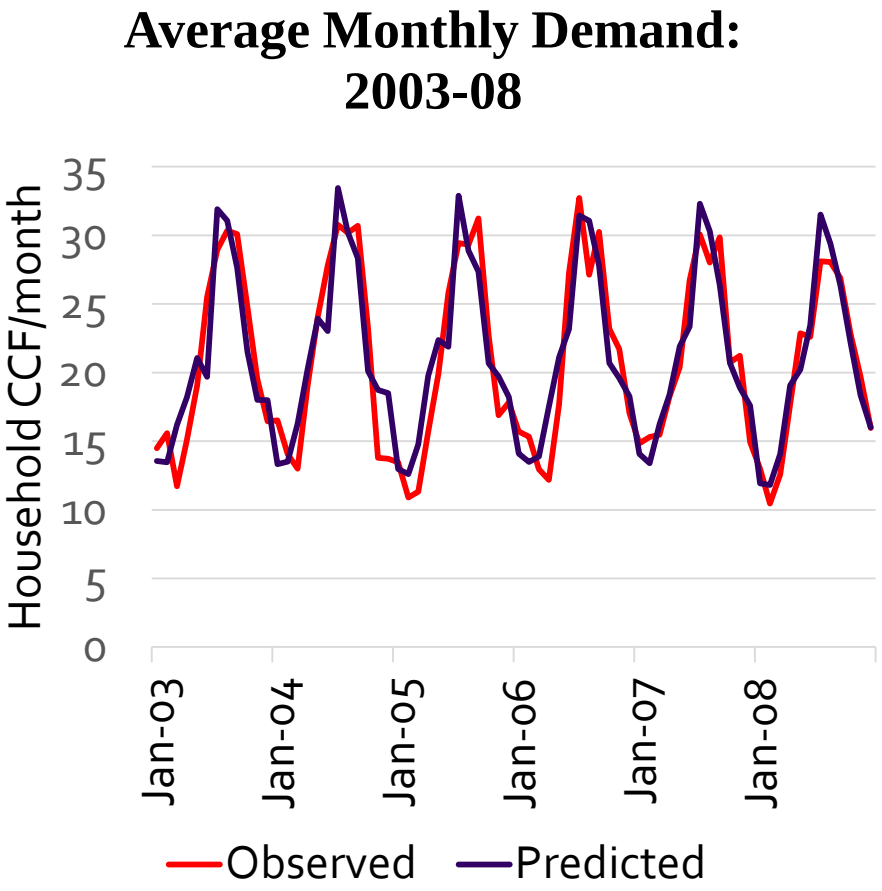
Source: MNWD GIS staff

Comparison of Water Districts

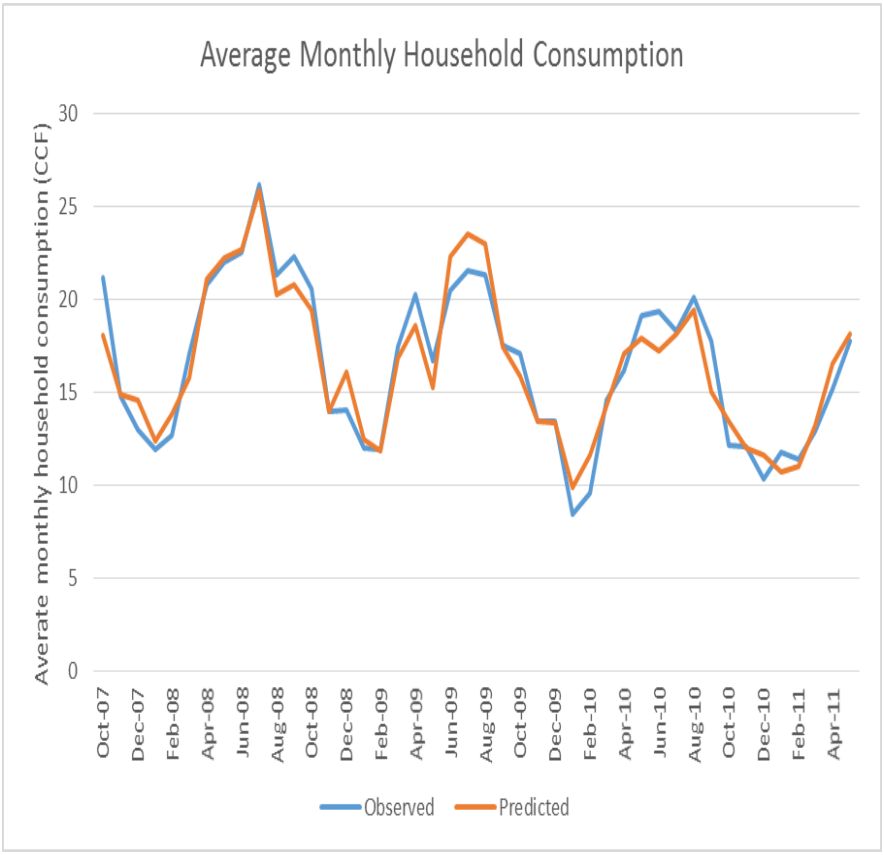
	EMWD	MNWD
Sample of accounts (single family residential accounts with continual service over entire study)	13,565 accounts	16,277 accounts
Time frame of analysis	Jan 2003 to Sept 2012	Oct 2007 to March 2015
Price structure change (date of change)	Uniform to allocation-based (April, 2009)	Fixed block to allocation-based (July, 2011)
ET (2008)	4.81 in/month	4.1 in/month
Monthly Budget	$226	$364
Usage (2008)	19.8 ccf/month	18.8 ccf/month

Step II: Estimation results: prior to rate change

EMWD

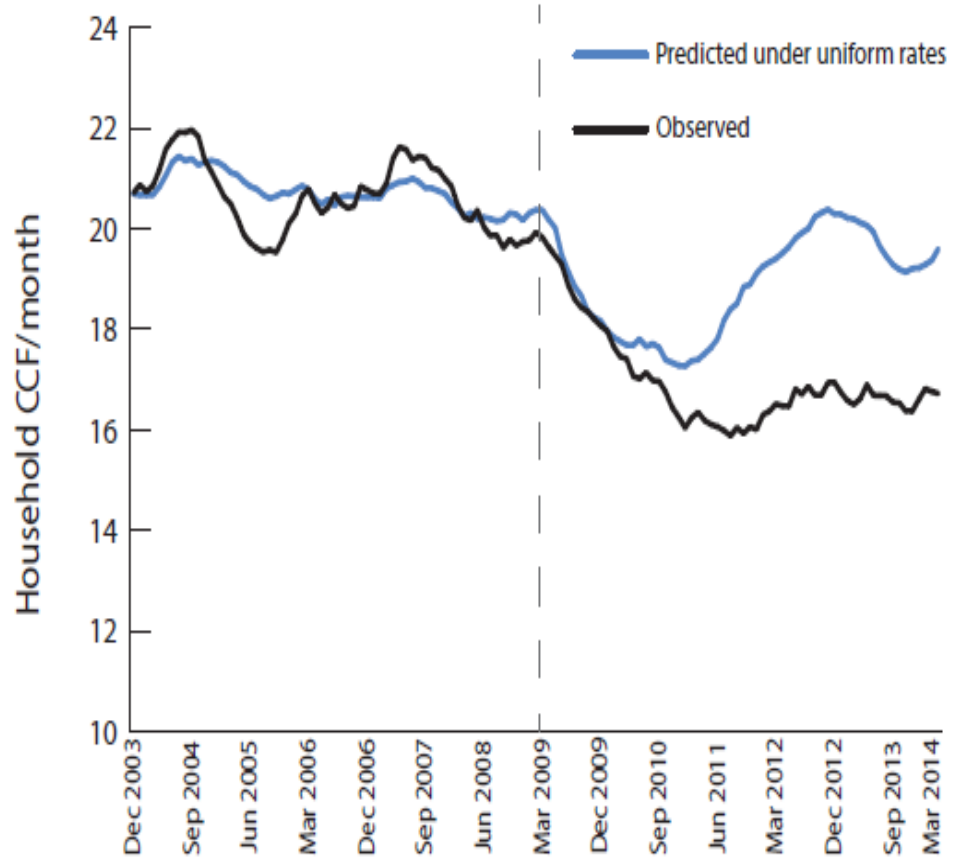


MNWD



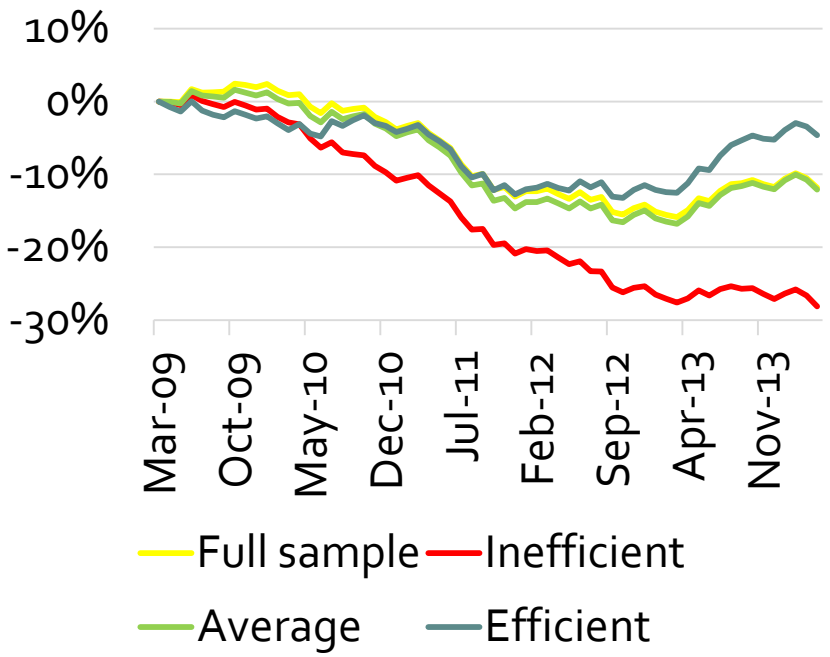
Steps III and IV:
Effects of Adoption of Water Budget Based Rates (EMWD)

Figure 1. Comparison of observed demand against model predictions.*

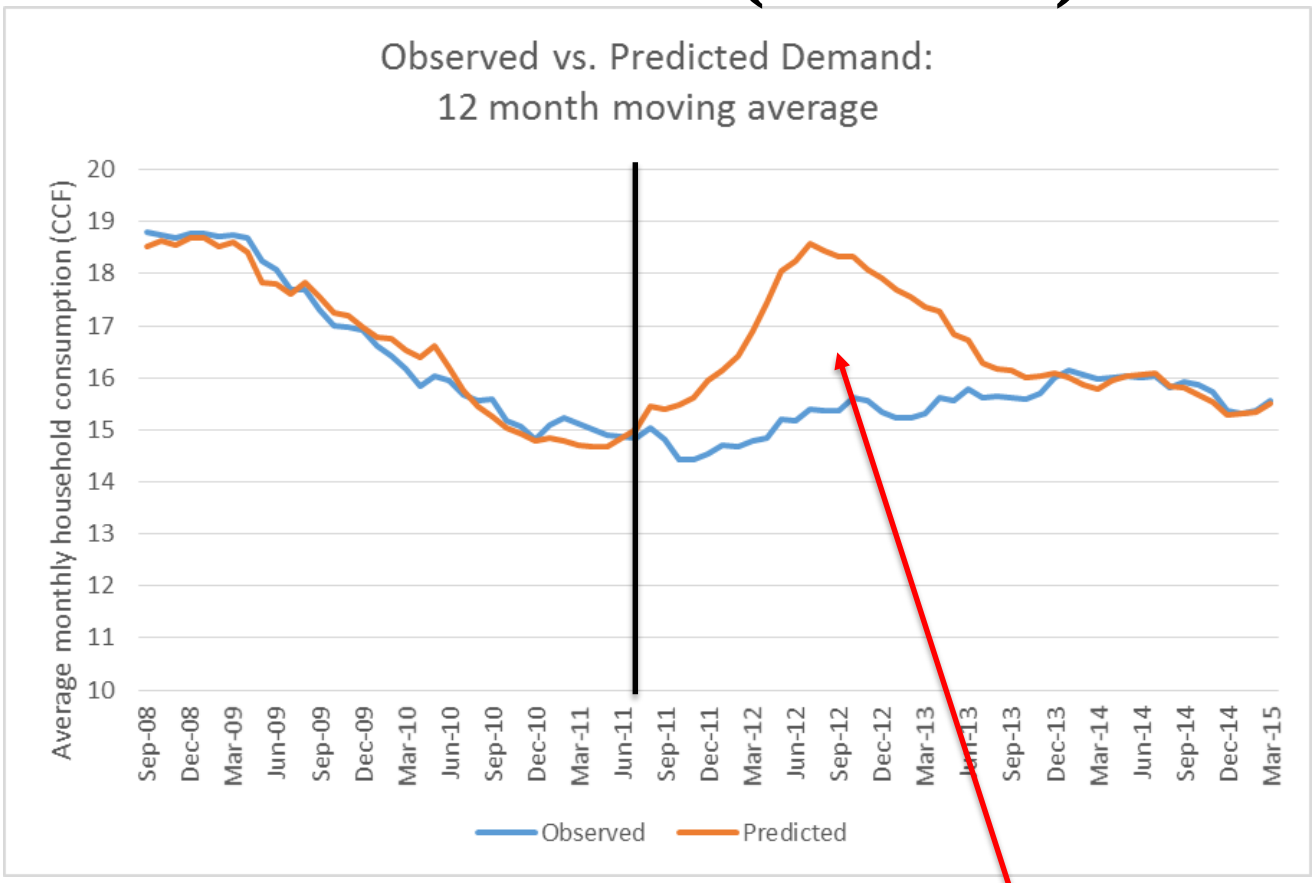


Vertical dashed line indicates the date when the water budget IBR price structure was implemented.

Demand reduction attributable to the rate change:
12-month moving average

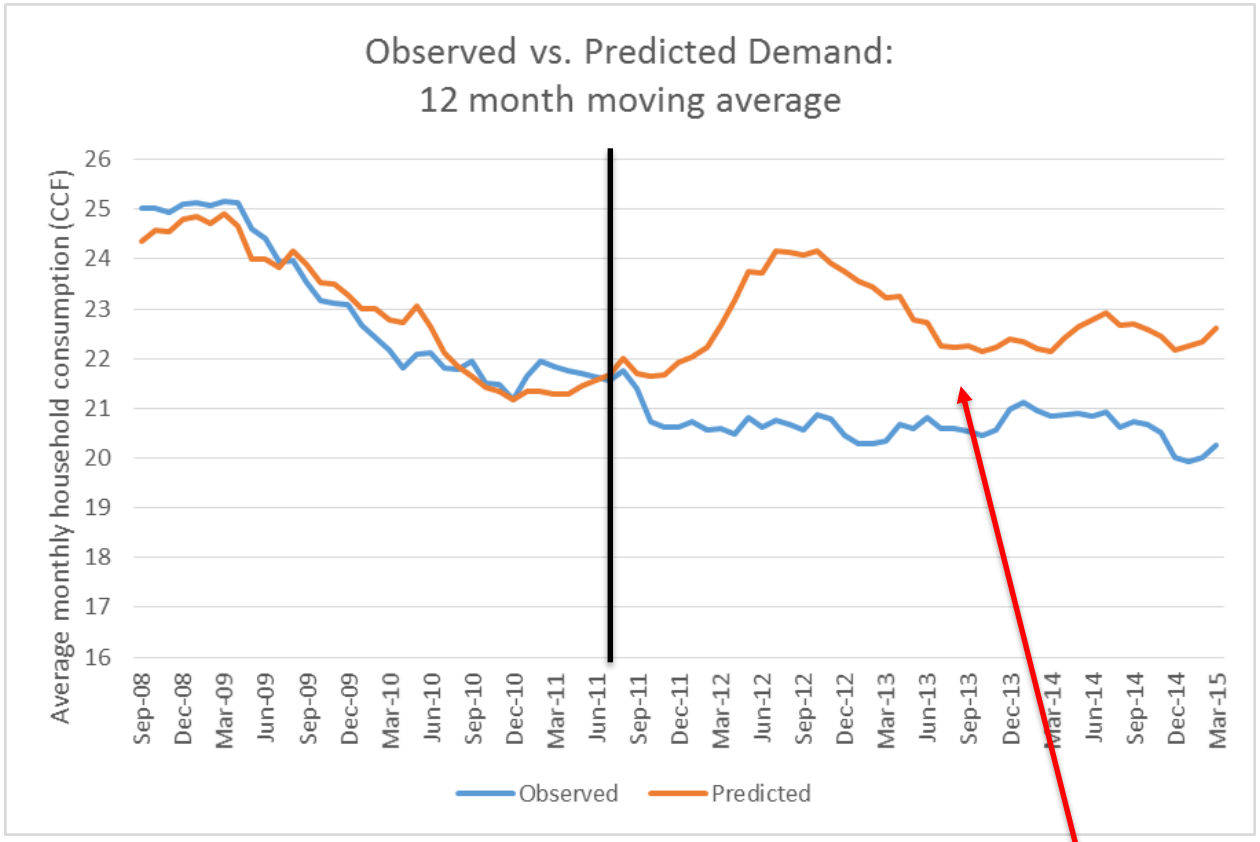


Steps III and IV:
Estimated demand effect (MNWD)



Temporary "peak shaving"
(1828 AF saved in sample)
(5280 AF saved district-wide)

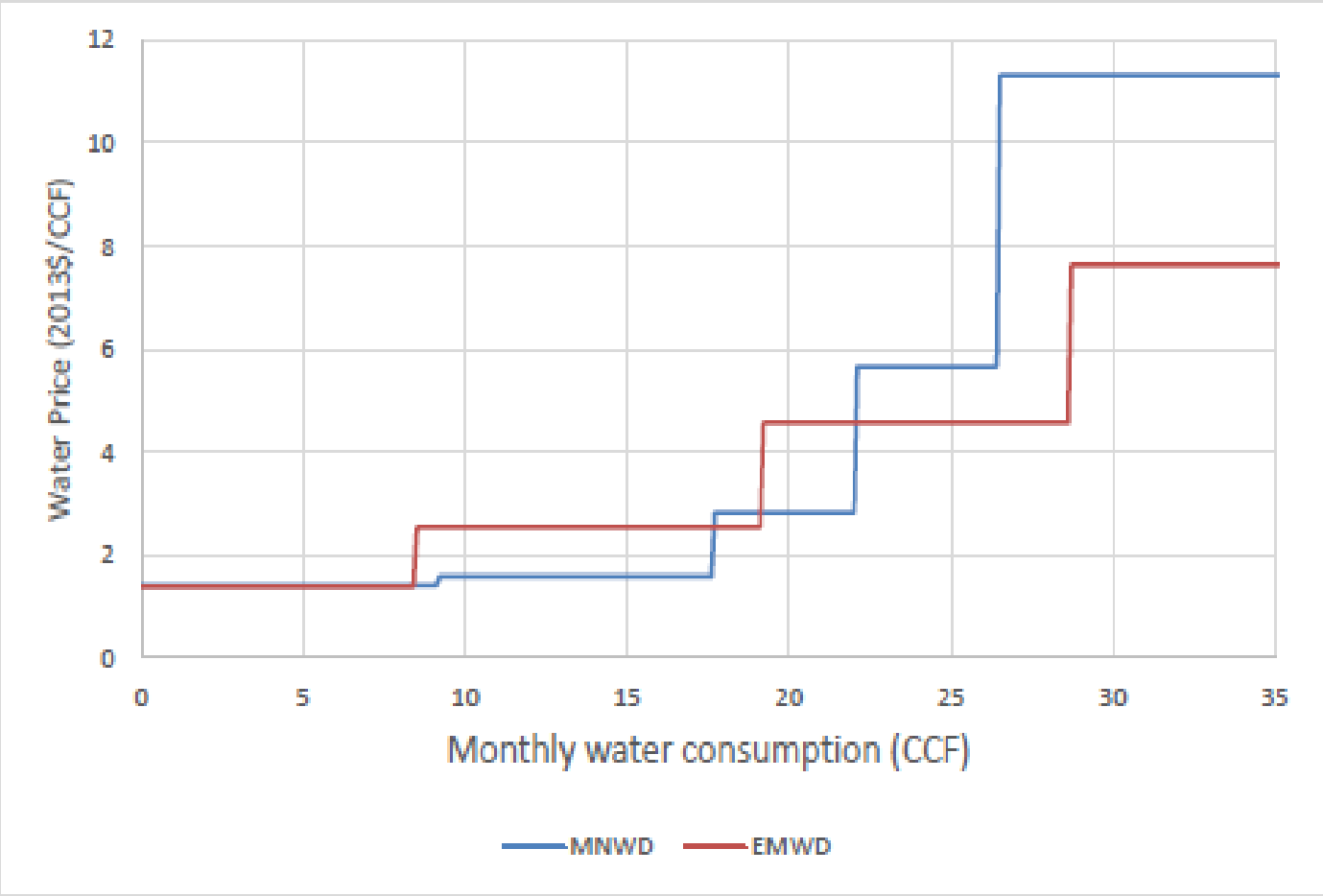
Steps III and IV:
Estimated demand effect for inefficient households (MNWD)



Persistent 5-15% reduction

Comparison of Allocation-based Rate Structure for "representative" household

(3.5 residents, 2900 ft^2 irrigated area, 4.4 inches ET/month)



How have allocation-based rates affected water demand?

EMWD

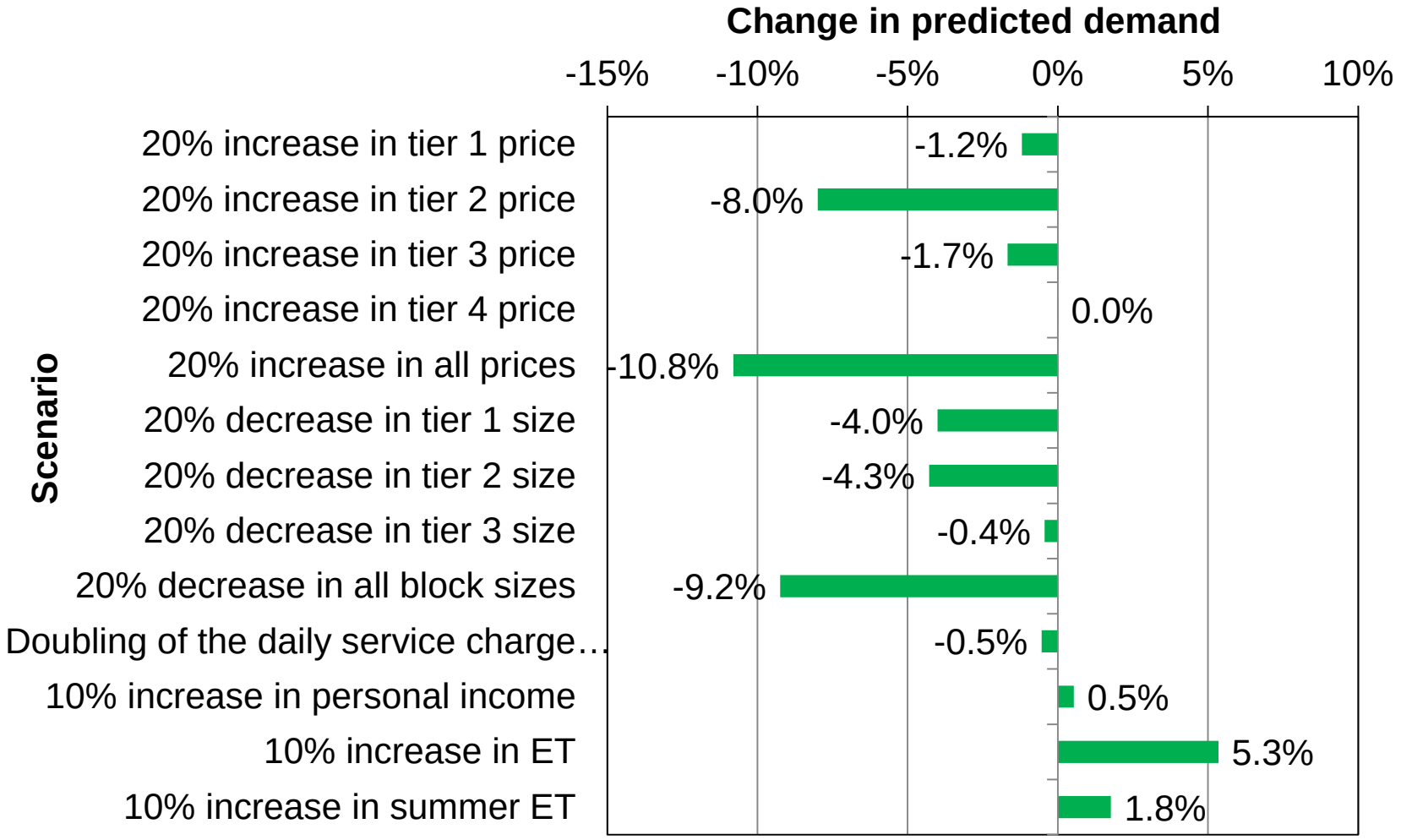
- (Scarcity) Estimated household usage was 10-15% lower than it would have been under equivalent uniform rates.
- (Efficiency) Most "inefficient" water users made largest and most resilient reductions
- (Equity) => Prices confronted and water bills of lower income group decreased

MNWD

- (Scarcity) Reduced consumption temporarily when irrigation demands are particularly high ("peak-shaving")
- (Efficiency) Reduced consumption persistently among inefficient customers (5-15% reduction)

=> Differences due to differences in price structure along with residential household characteristics

Estimation Strategy Part 2 - Block-Rate Model Scenario Analysis



Allocation-based Rates

Potential Challenges….

- Proposition 218: the "Right to Vote on Taxes Act"
  - Passed in 1996, amended the California constitution
    - Generally limits local government ability to assess taxes and fees on landowners
  - Local government fees must not exceed:
    - The reasonable cost of providing the service
    - The proportional cost of providing the service to each parcel served
  - In 2006, California supreme court ruled that it applies to water rates
    - Agencies may not charge more for water than it costs
    - Agencies may not cross-subsidize water costs

Allocation Based Rates: Recent Legal Cases

2011: City of Palmdale v. Palmdale Water District

- Plaintiffs argued that block rates were not "proportional" to cost of service
- Trial court ruled for PWD; appellate court ruled for plaintiffs
  - PWD failed to demonstrate proportionality
  - But budget-based rates *d/n necessarily* violate Prop 218

2013: Capistrano Taxpayers Assn. v. City of San Juan Capistrano

- Plaintiffs made a similar "proportionality" argument
- Trial court ruled for plaintiffs; appellate court ruled against city's methods, not validity of ABR in being consistent with Prop 218

Court of Appeal, Fourth District, Division 3, California.

CAPISTRANO TAXPAYERS ASSOCIATION, INC., Plaintiff and Respondent, v. CITY OF SAN JUAN CAPISTRANO, Defendant and Appellant.

G048969

Decided: April 20, 2015

"We conclude the trial court erred in holding that Proposition 218 does not allow public water agencies to pass on to their customers the capital costs of improvements to provide additional increments of water – such as building a recycling plant."

"However, the trial court did not err in ruling that Proposition 218 requires public water agencies to calculate the actual costs of providing water at various levels of usage."

Allocation Based Rates: An economist's view

- Courts appear to be invalidating opportunity costs
  - True cost of using water is the budgetary cost to deliver it plus the foregone benefit it may have generated in another, possibly future, use
  - Omitting opportunity costs encourages inefficiently high levels of use
  - May constrain drought-responsive (conservation) pricing
- Courts appear to be undermining potential gains from trade
  - Markets tend to promote cost-effective, mutually beneficial solutions
  - City of SJC was attempting to facilitate a market-like transaction
  - Current interpretations of Prop 218 ironically may increase costs
- Prop 218 makes it difficult to keep water affordable for low income households
  - Tinbergen Rule: each "objective" requires its own policy tool
  - Gives rise to need for statewide program (lifeline rates) similar to electricity, weatherization, and telephones

Conclusions

Demand-side measures are increasingly being considered to address water scarcity

- ***Potentially lower cost option***
- ***Requires understanding of behavior to be effective***

Prices are shown to be a more cost-effective tool to reduce demand relative to non-price instruments

- ***People respond to prices***

Prices are most effective when used with other complementary strategies

- ***Portfolio of approaches are needed to deal with efficiency, equity and financial stability concerns***

Challenging for any pricing structure to address scarcity (efficiency), equity, and revenue stability issues

- ***Allocation based rates have many attractive options…but challenged with current regulatory environment***

Informed and sophisticated demand models can be useful

- ***Identify how water demand and revenues will be influenced by changes in economic, demographic, or environmental conditions***
- ***Identify efficient, equitable, and revenue neutral management response to such changes***