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Allocation-Based Pricing, Household Water Demand and Consumer Welfare in California

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How should water be priced?

- Three common goals of a water price structure:
  - Efficiency: send an appropriate marginal cost signal
  - Equity: ensure affordability for essential uses
  - Financial stability: maintain a balanced budget

Common rate structures

- Flat rate: a fixed charge per billing period
- Uniform rate: a constant price per unit consumed
- Increasing block rate: price per unit depends on amount consumed
- Allocation-based rate: blocks depend on household and environmental characteristics

Water pricing in California

- As of 2005: about half of all public utilities (400+) were using increasing block rates
- As of 2008: fewer than 14 utilities were using allocation-based rates
- From 2009-2011: 9 more utilities adopted allocation-based rates
  - Major driver: Governor's *20x2020 Water Conservation Plan*
- Why the apparent reluctance to adopt allocation-based rates?
  - Short-term cost
  - Long-term financial risk
  - Legal questions
  - ***Uncertain effect on demand***: is it worth the cost/risk?

Case study #1: EMWD

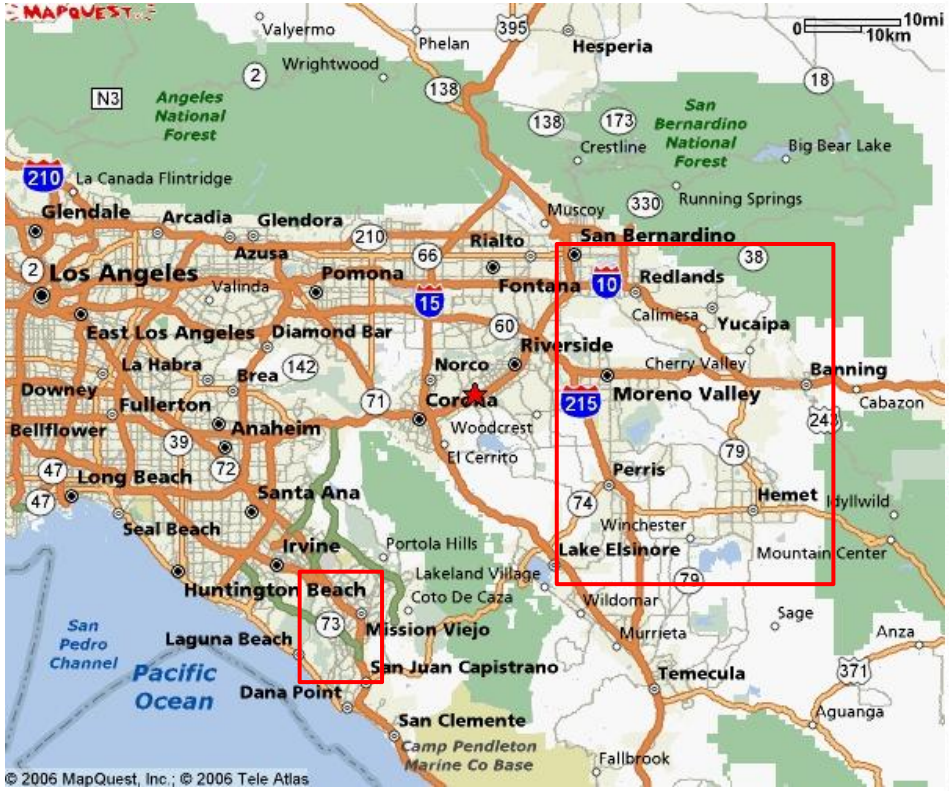
Eastern Municipal Water District (EMWD) switched from uniform rates to increasing block allocation-based rates in April 2009:

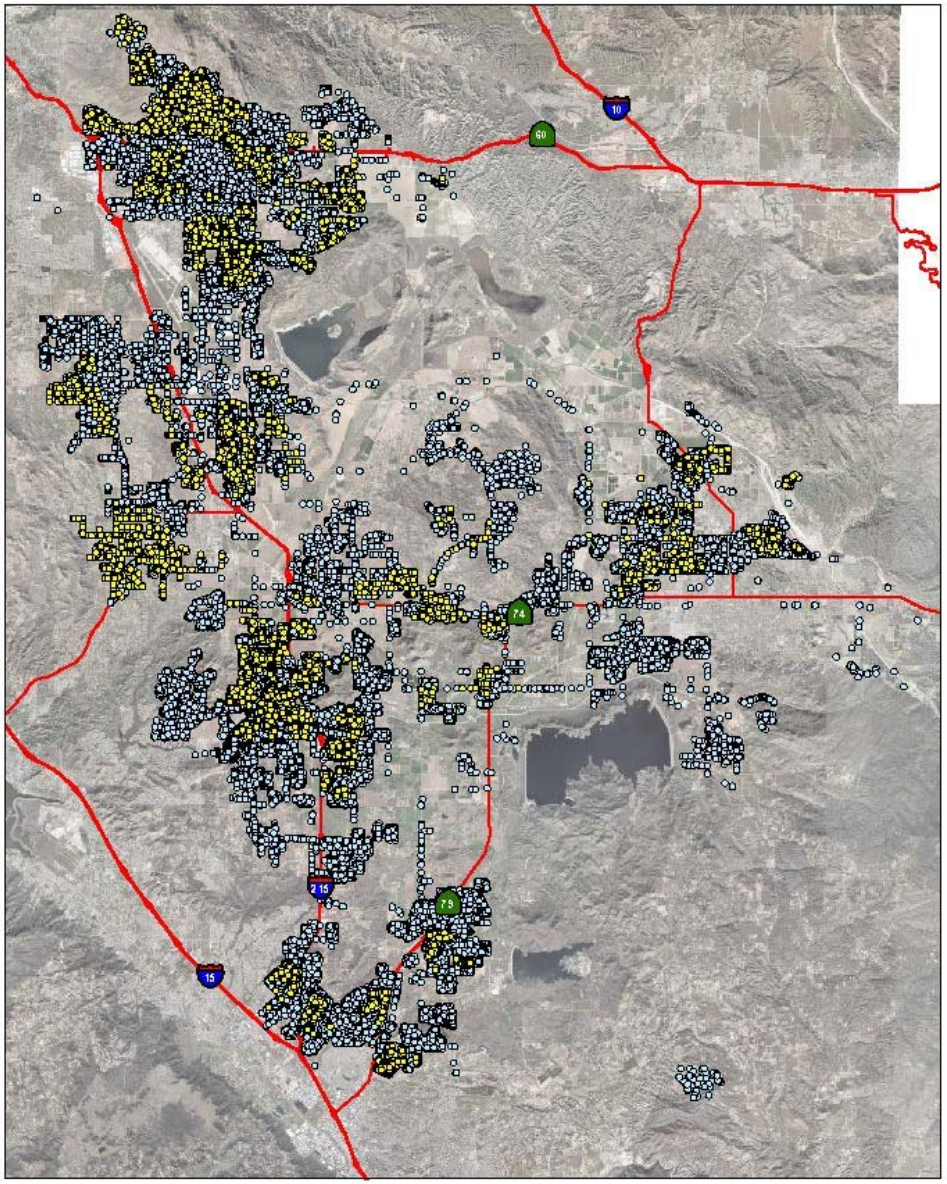
- *Indoor* water use: $w_1 = (HHS \times PPA) \times DF + IV$
- *Outdoor* water use: $w_2 = (ET \times CF \times IA + OV) \times DF$
- *Excessive* water use: $w_3 = \frac{1}{2}(w_1 + w_2)$
- *Wasteful* water use: in excess of w_3

Goal was to promote conservation while maintaining fiscal balance

→ *How much conservation did they achieve?*

Data: spatial distribution of sample households



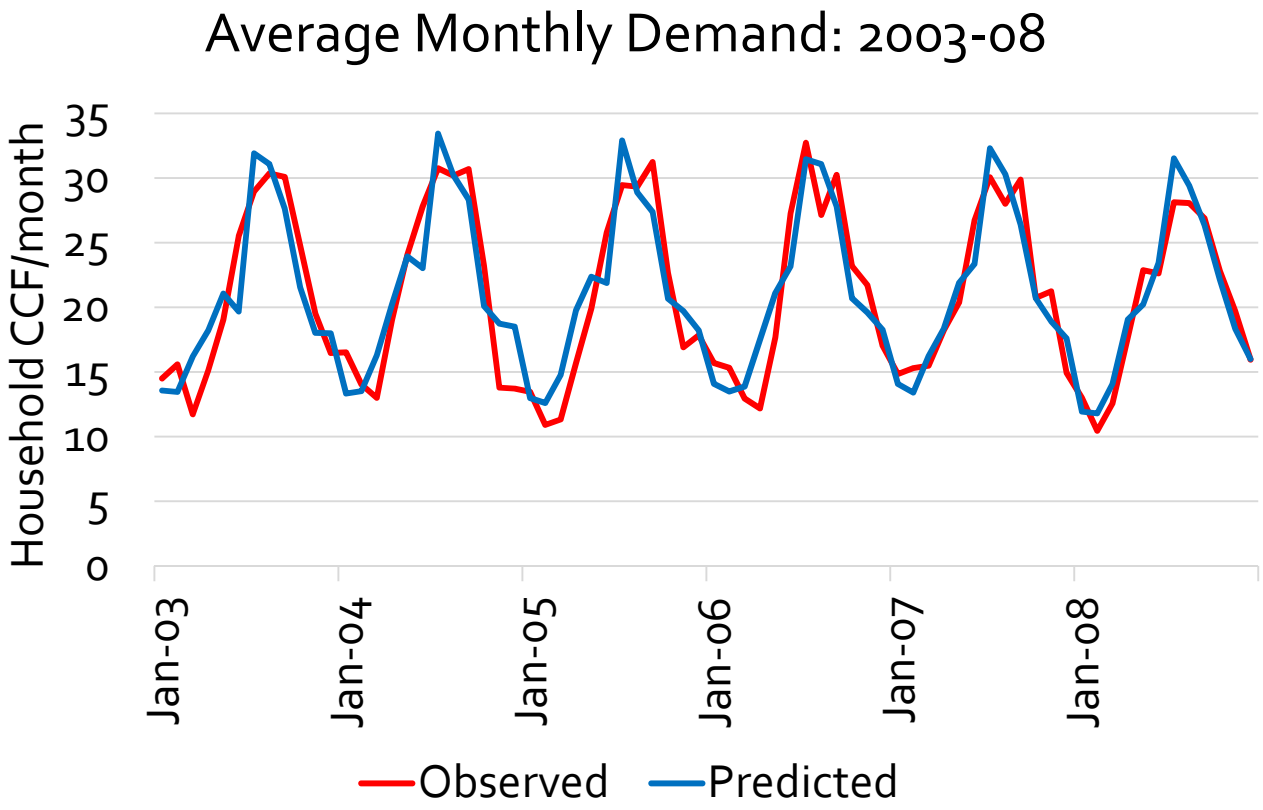


- Sample accounts
- All water service connections

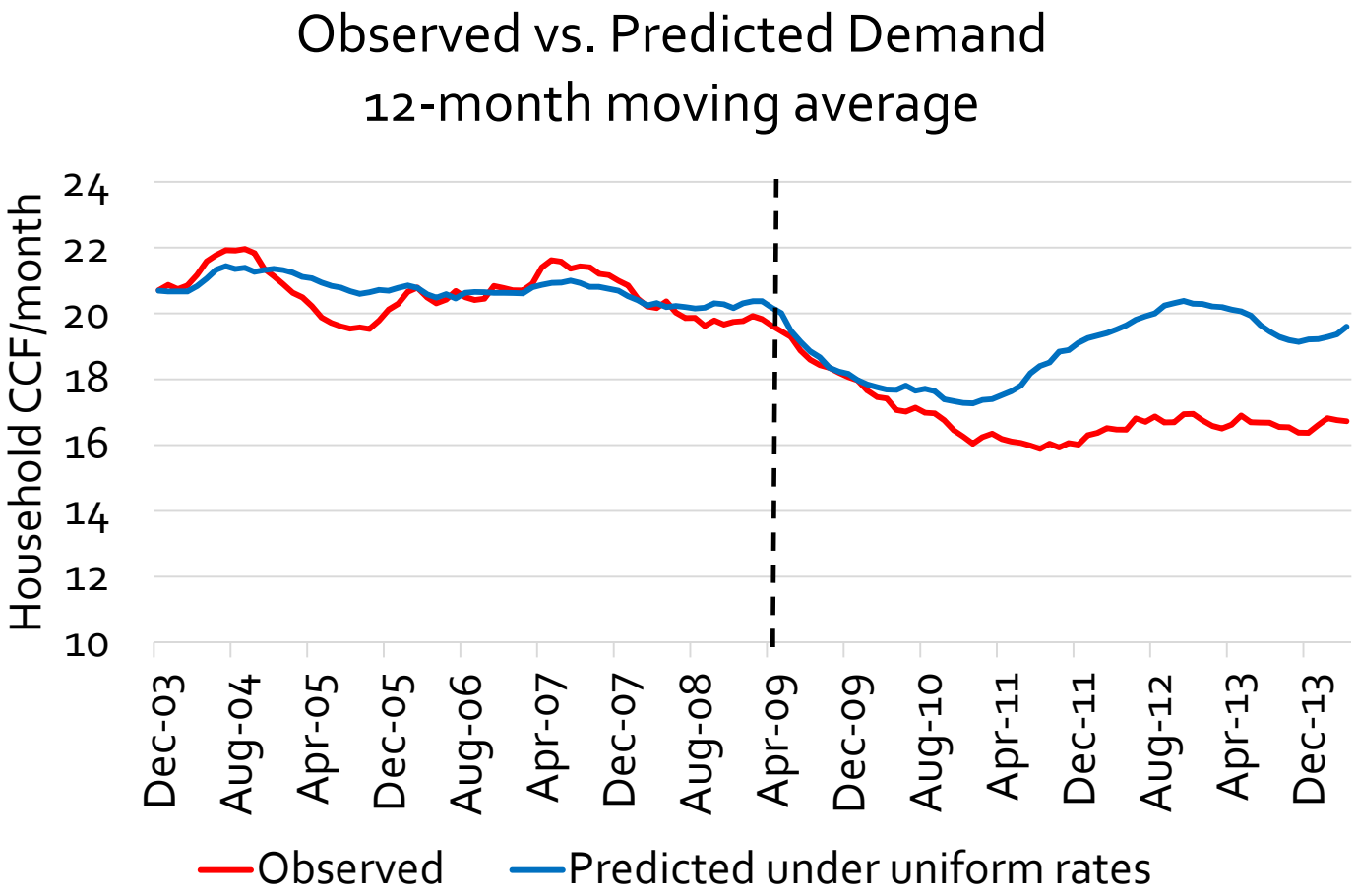
Estimation strategy

- Estimate a uniform rate demand model using data from January 2003 – December 2008
  - Estimated with household-level fixed effects
- Use the model to predict demand from April 2009 – April 2014 under equivalent uniform prices
- Difference between actual and predicted demand is the water budget-induced demand effect

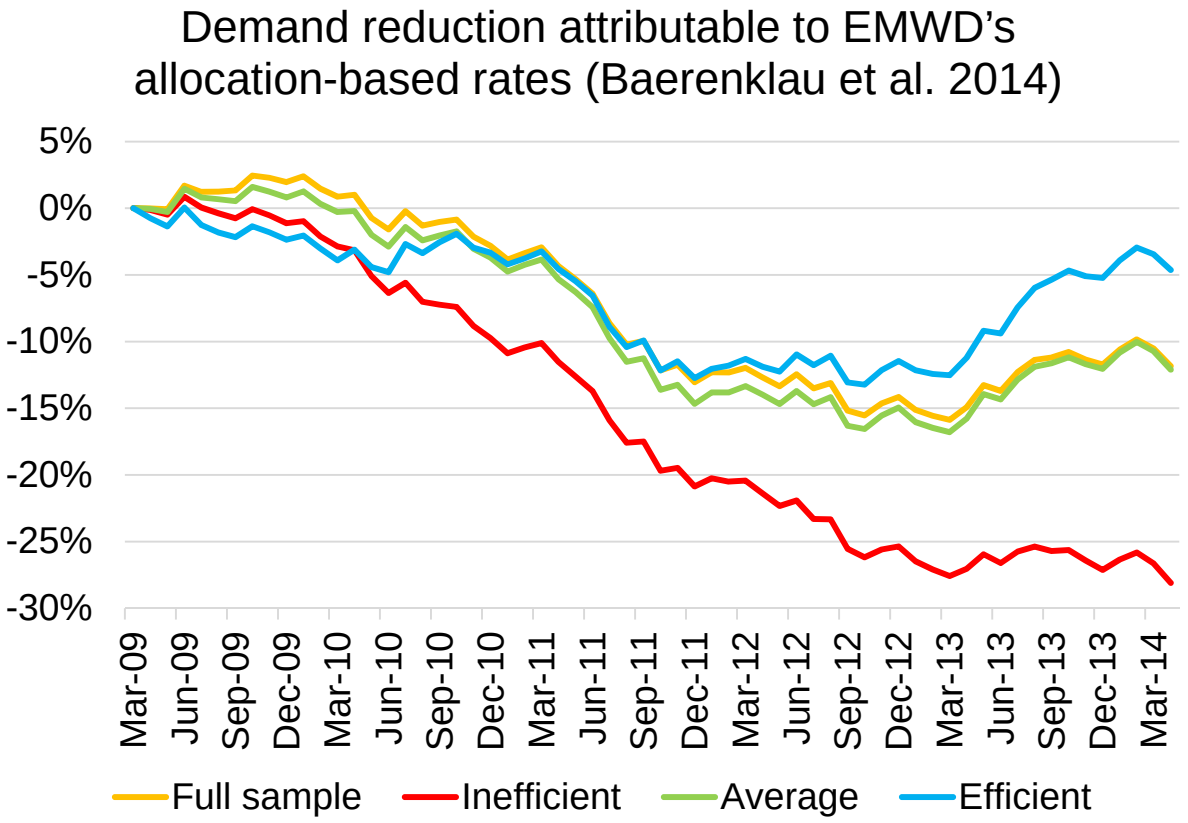
Estimation results



Estimated demand effect



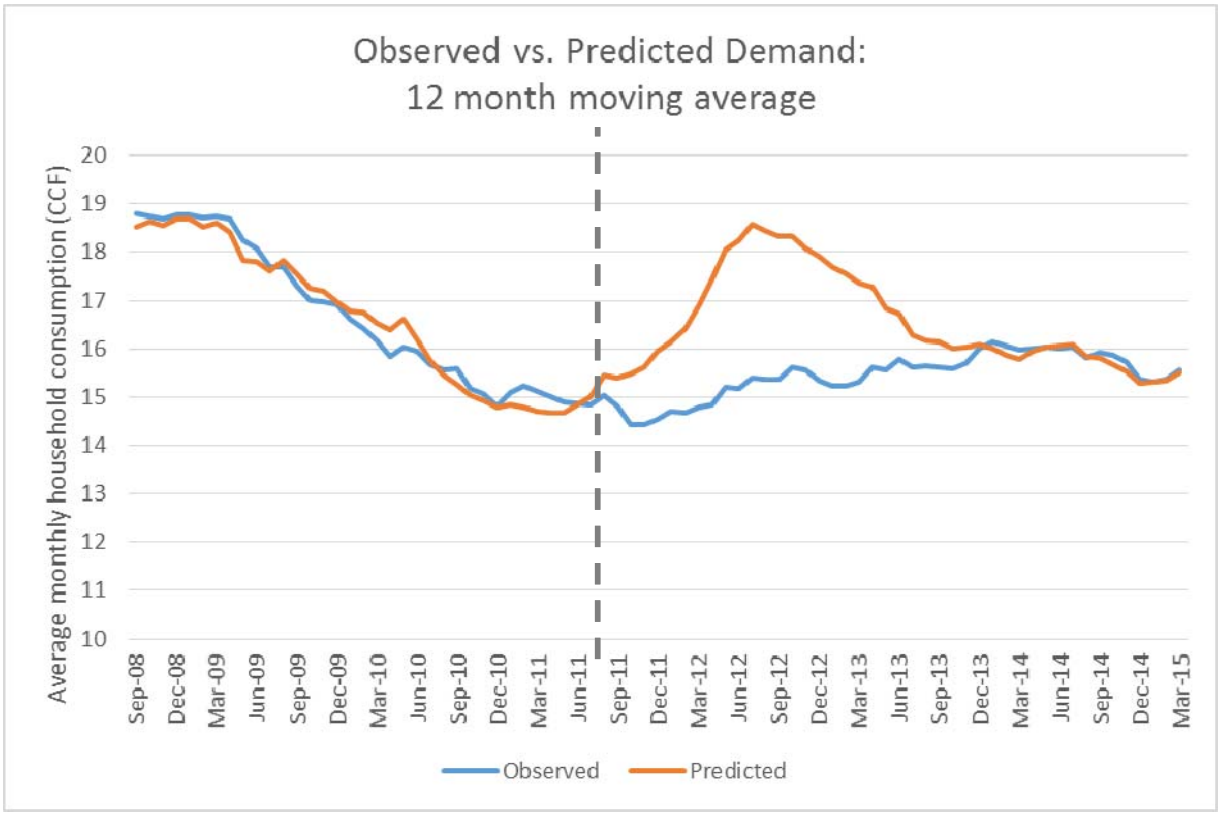
Larger, more persistent effects on inefficient users



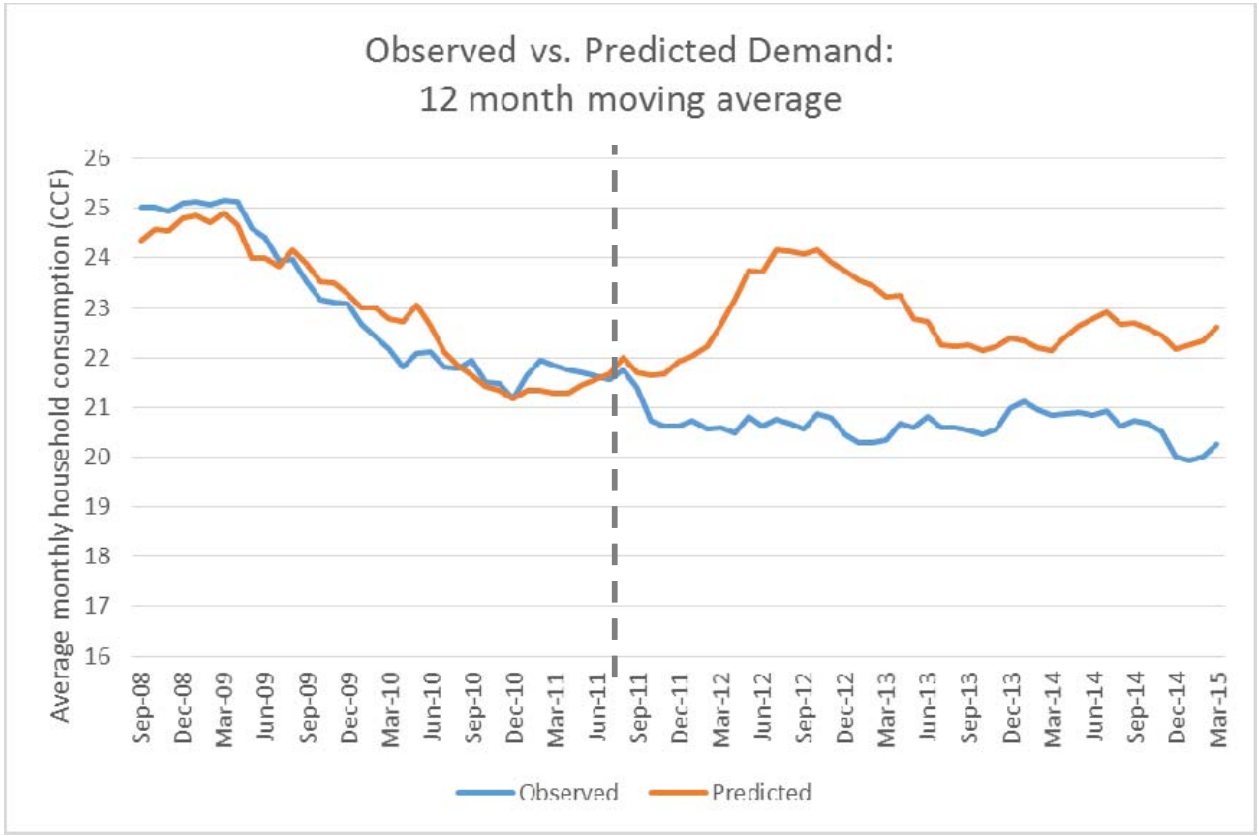
Welfare effects under alternative policies

	Allocation-based rates	Price increase	Price increase with fixed cost decrease	Quantity restriction	Quantity restriction with fixed cost increase
Minimum EV ($/month)	-170.93	-150.97	-139.95	-7.26	-16.41
Mean EV ($/month)	1.98	-15.29	-7.40	-0.61	-7.26
Median EV ($/month)	5.70	-13.73	-5.82	-0.52	-7.16
Maximum EV ($/month)	168.28	-0.99	7.10	-0.04	-6.69
# of better-off households	8455	0	2298	0	0
% of better-off households	62%	0%	17%	0%	0%
Mean equivalent variation ($/month) by income terciles					
Top third	4.99 (1.4%)	-15.78 (-4.4%)	-7.90 (-2.2%)	-0.60 (-0.17%)	-7.24 (-2.0%)
Middle third	2.51 (0.8%)	-14.69 (-4.6%)	-6.78 (-2.1%)	-0.59 (-0.18%)	-7.23 (-2.3%)
Bottom third	-1.57 (-0.6%)	-15.42 (-5.5%)	-7.51 (-2.7%)	-0.65 (-0.23%)	-7.30 (-2.6%)

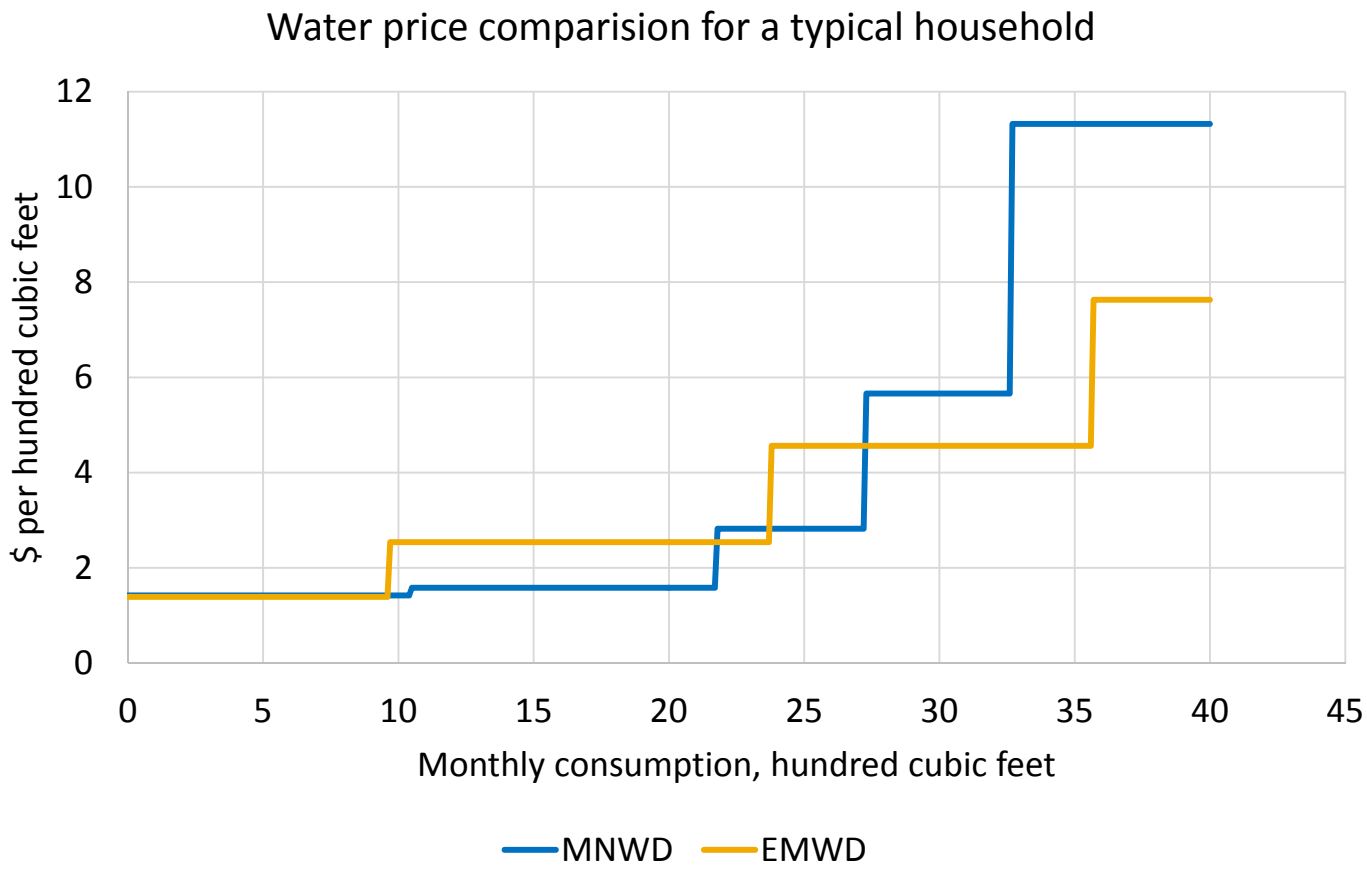
Case study #2: MNWD



Effect on inefficient households



Rate structure comparison



Summary: demand effects

- Demand reduction of up to 15% overall, and up to 30% by inefficient users, across two water districts.
  - Larger reductions when initial efficiency is lower.
  - Larger reductions when mid-tier prices are higher.
- Reductions by inefficient users are the most resilient to changing conditions that would otherwise tend to increase demand.
  - Consistent with a price-induced “ratcheting effect”: higher prices create new habits that become permanent.
- EMWD: Real average prices rose ~3% under water budgets, but would have had to rise ~30% under uniform pricing to achieve the same demand effect.
  - Significant conservation potential while also addressing equity concerns.