# This presentation premiered at WaterSmart Innovations

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# Prices, Programs, and Persuasion

## What Induces Demand-Side Water Conservation? (a wee bit of empirical evidence)

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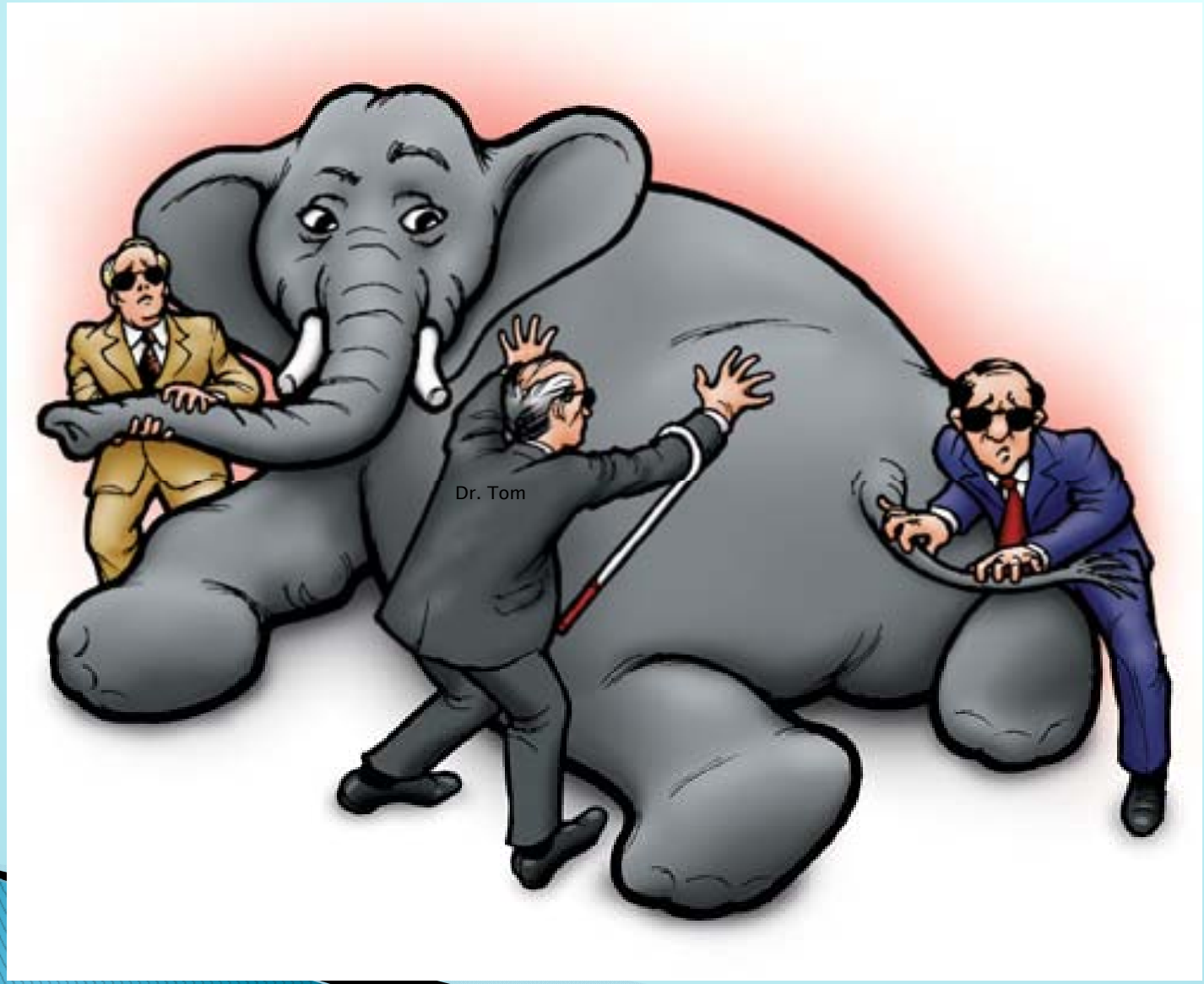
# Water Demand today

- Water demand, like energy demand, is changing

- Water utilities are engaged in purposive water conservation efforts
  - Helps contain infrastructure costs
  - Manages growth-related demand
  - Improves reliability – reduces shortage costs
  - Gives customers choices

# Different notions of water demand



# Different notions of water demand

- Engineer – may view demand in terms of "demand load" – a production requirement, need
- Water Planner – water demand as supply provided, use
- Wastewater Planner – concerned with water use not consumed, but disposed
- Financial Planner -- demand as revenue-producing consumption;
- Economist – demand as a choice-based relationship between quantity and price, sometimes conditional on quality and reliability

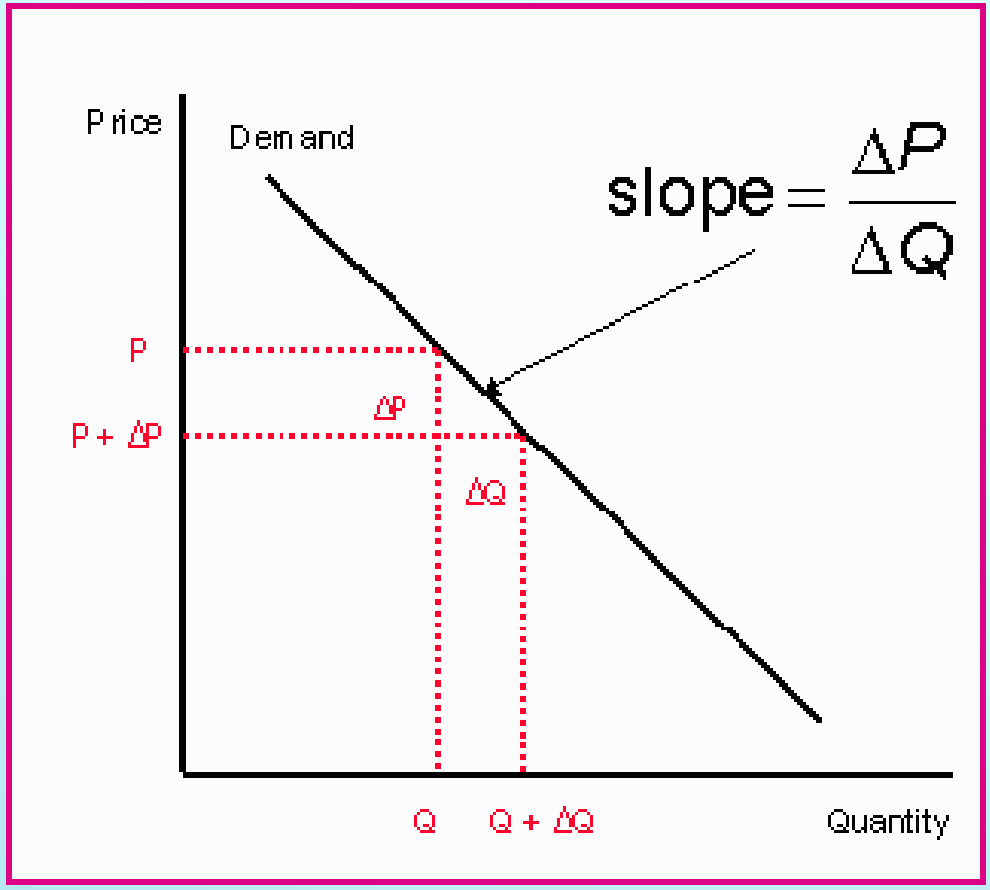
# What induces Conservation?

- Three drivers of water conservation
  - Pricing
  - Programs
  - Persuasion
- Is this an either/or choice?
  - "Just get the message right and customers will do the right thing."
  - "Just get the price right (set water rates to an efficient price), and customers will move to efficient levels of use."
  - "Just implement the right set of conservation programs, and efficient water use will occur."

# What do we know about water conservation?

- Price-induced Customer Conservation
  - Lots
  - More than 138 studies of price's effect on water demand
- Program-induced Customer Conservation
  - Much—more than 50 empirical impact evaluations
  - Depends—on the program and the customer
- Persuasion (Media, Public information)-induced Customer Conservation
  - Not so much
  - It depends
  - It varies

# Price elasticity of demand illustrated

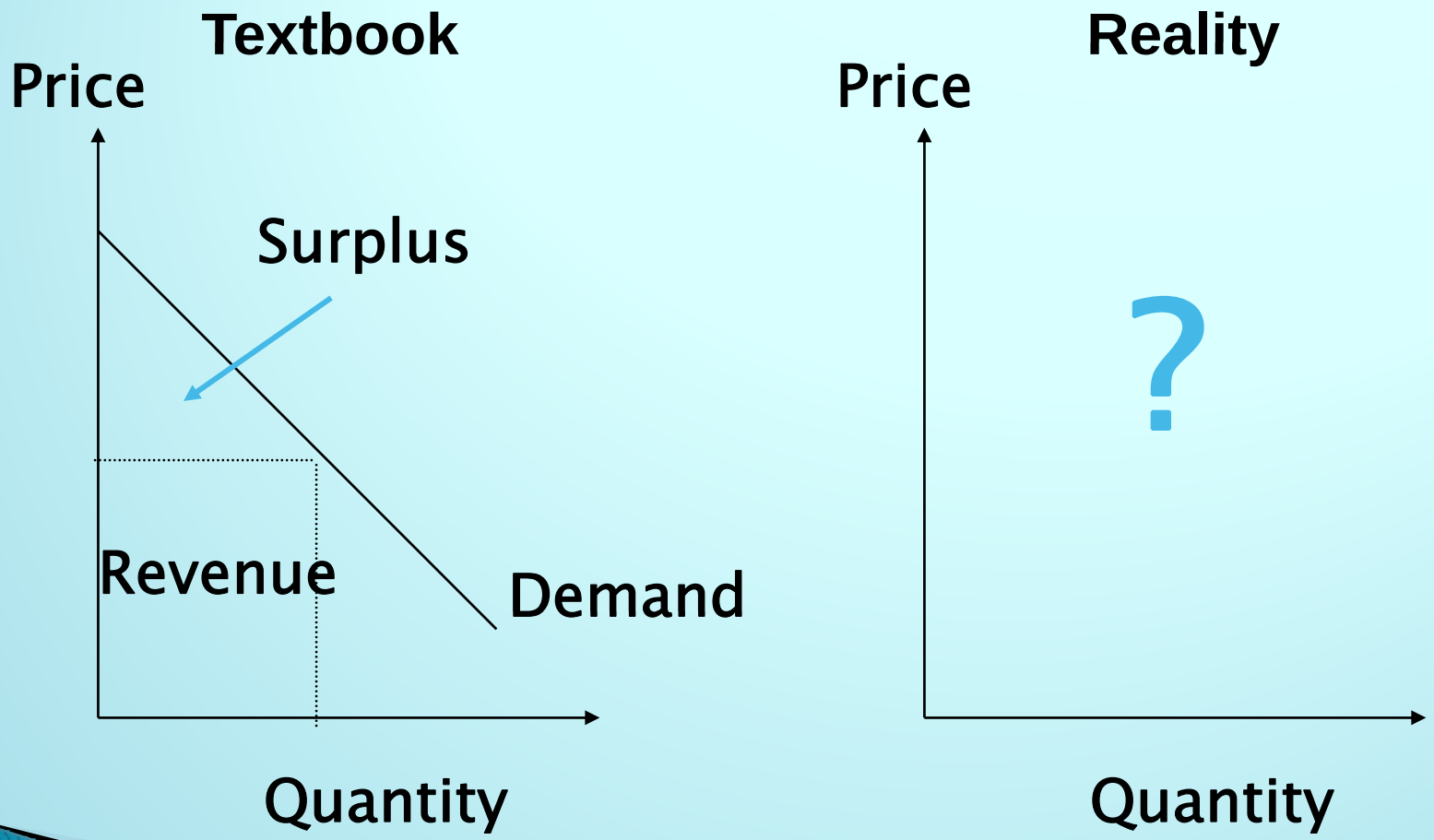


# Sample elasticities (general)

| | | |
|---|---|---|
| SALT, MATCHES, TOOTHPICKS | .10 | Relatively inelastic |
| NATURAL GAS (SHORT-RUN) | .10 | |
| AIRLINE TRAVEL (SHORT-RUN) | .10 | |
| GASOLINE (SHORT-RUN) | .20 | |
| COFFEE | .25 | |
| NATURAL GAS (LONG-RUN) | .50 | |
| PHYSICIAN SERVICES | .60 | |
| GASOLINE (LONG-RUN) | .70 | |
| MOVIES | .90 | Unitary elasticity |
| PRIVATE EDUCATION | 1.1 | |
| HOUSING (OWNER-OCCUPIED) | 1.2 | |
| RESTAURANT MEALS | 2.3 | Relatively elastic |
| AIRLINE TRAVEL (LONG-RUN) | 2.4 | |
| FRESH GREEN PEAS | 2.8 | |
| CHEVROLET AUTOMOBILES | 4.0 | |
| FRESH TOMATOES | 4.6 | |

Source: Gwartney and Stroup, 1997

# How customers value end uses



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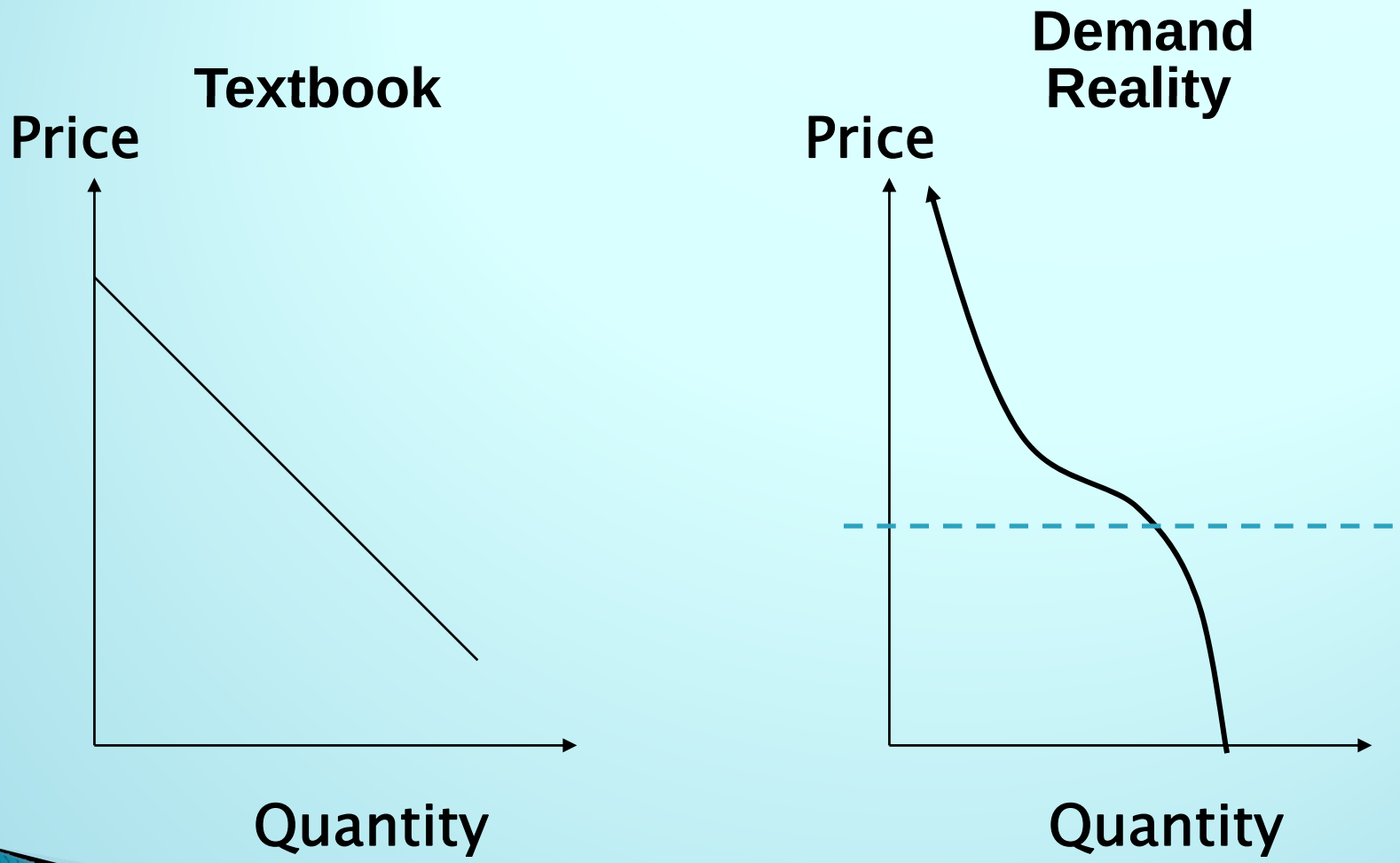
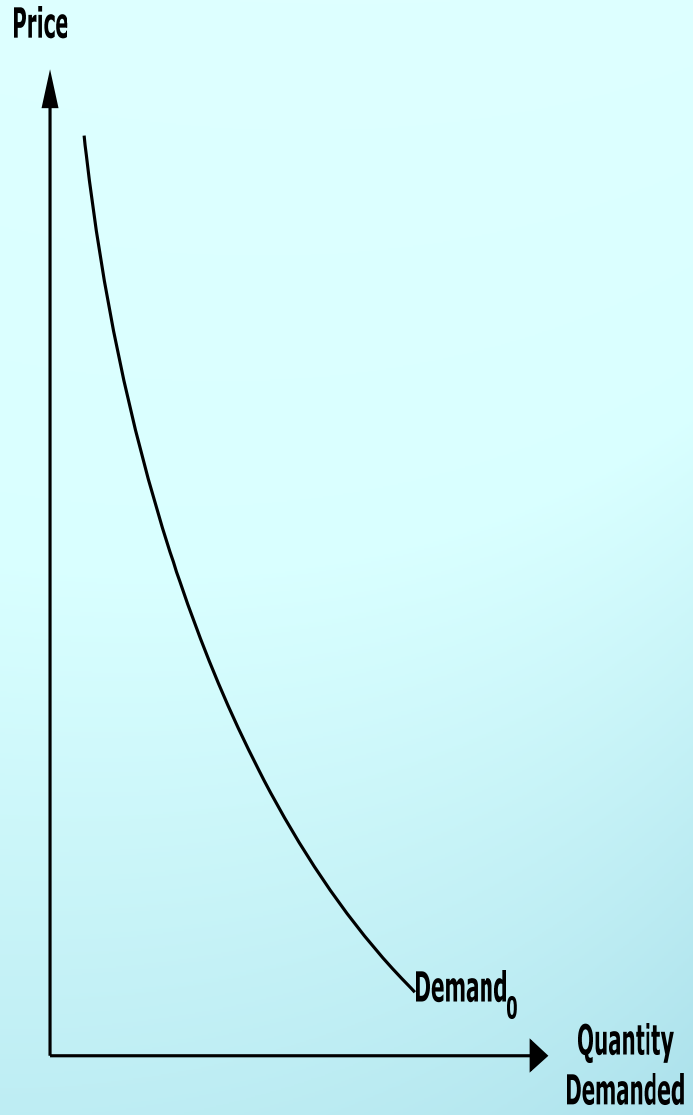


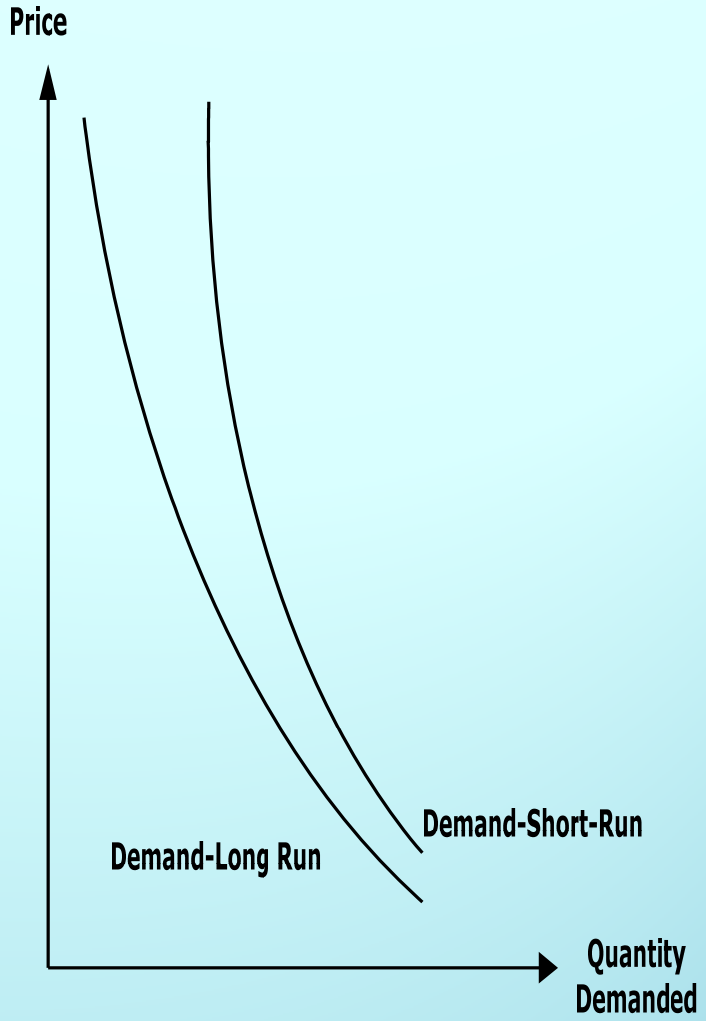
# Or more accurately for Water Demand…

- Customers display significant willingness to pay for safe, reliable water
- Evidence from empirical studies of urban water demand suggest very inelastic demand
- Translated, this means water use is very valuable to customers



# Demand is more elastic in the long run

- In the short-run, customers are stuck with their existing water-using equipment; Only behavior changes
- In the long-run, customers can replace water-using fixtures.



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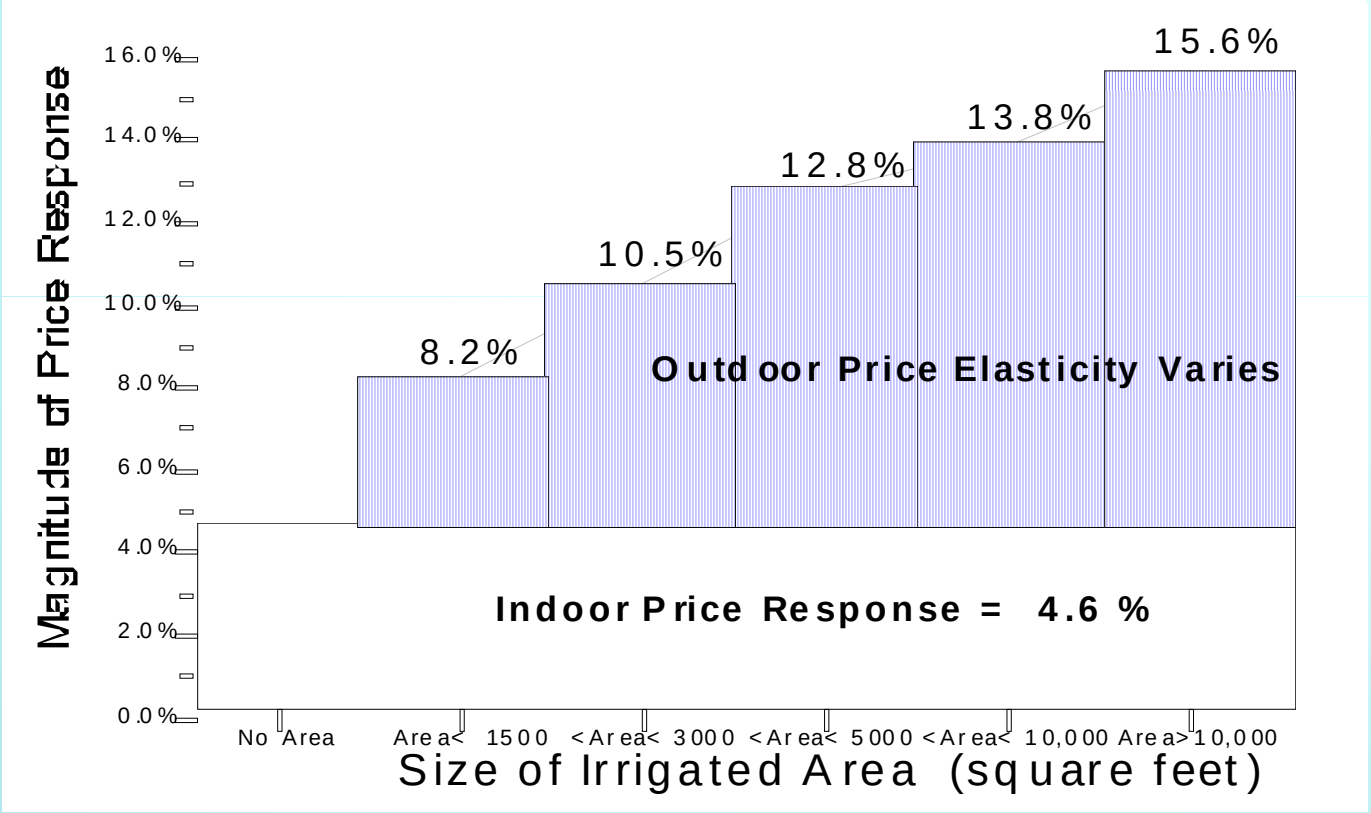



Source: Chesnutt, et al. (1995), *ULF Toilet Programs*

# Short-Run Elasticity Estimates

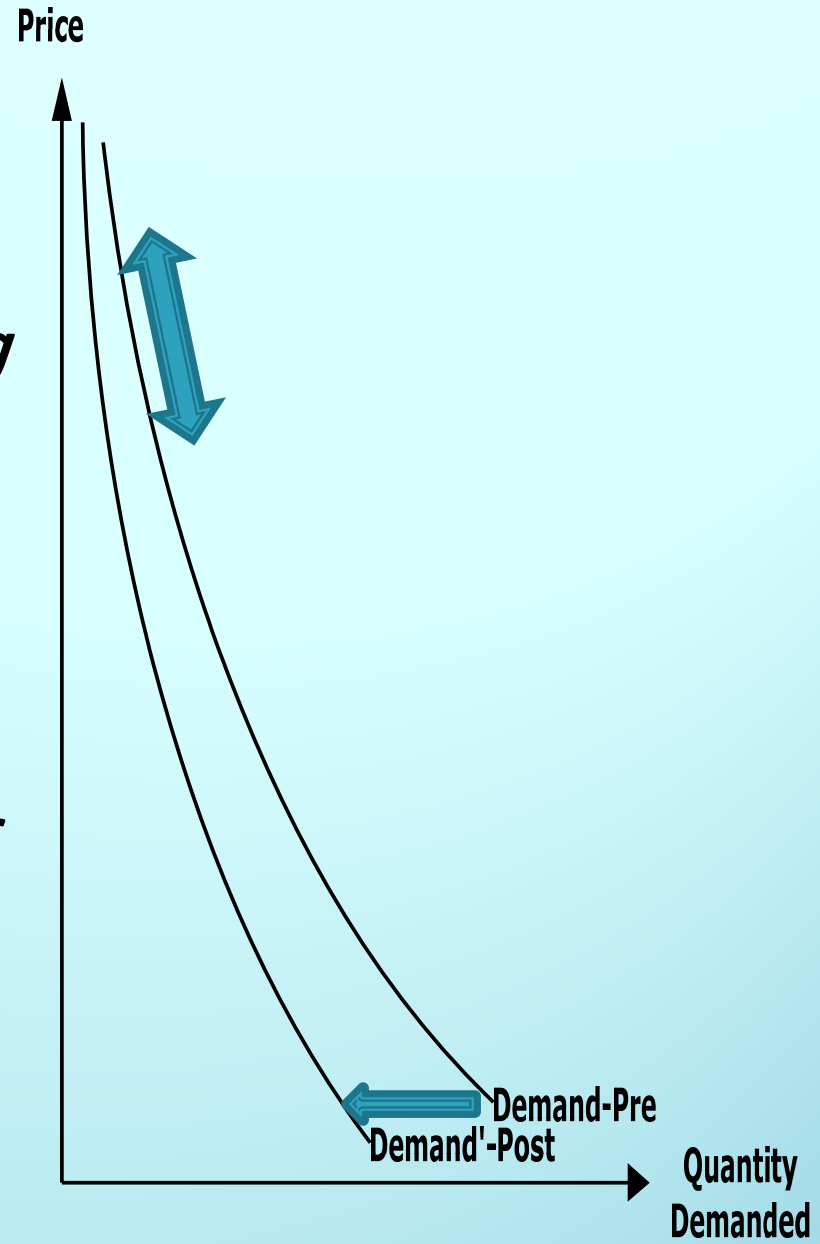
| **Single Family Residential** | **Range of Estimates** |
|---|---|
| Winter season | -.00 to -.10 |
| Summer season | -.10 to -.20 |
| **Multiple Family Residential** | |
| Winter season | -.00 to -.05 |
| Summer season | -.05 to -.10 |

**Chesnutt, et al. , Designing evaluating, and Implementing Conservation Rate Structures**

# Punchline: How Prices and Programs Affect Water Demand

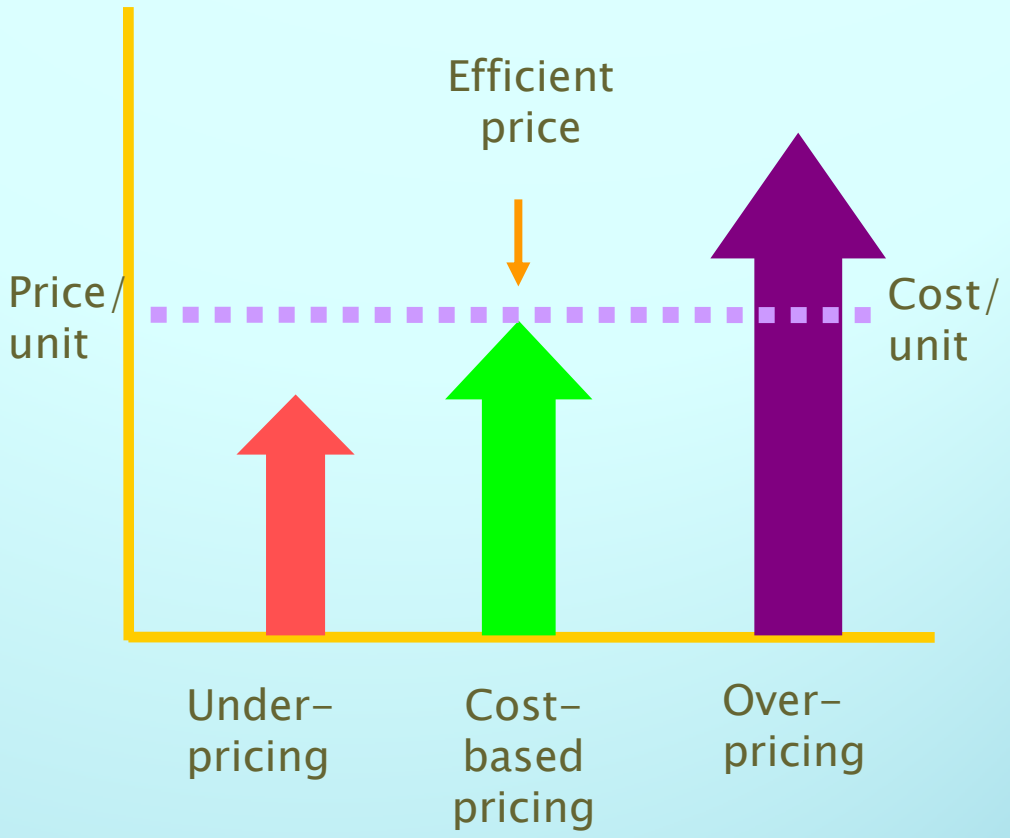
- Price ***causes*** movement ***along*** a Demand Curve

- Device-based Programs ***shifts*** the entire short-run demand demand curve



# Pricing and efficiency

- An important criterion, esp. for resource allocation and use
- Prices too low encourage excess (wasteful) usage, which in turn can lead to too much investment in capacity
- Prices too high discourage use and can be harmful to consumers



# Non-Price-Induced Water Conservation

- Non-drought savings studies
  - Landscape irrigation equipment, water budgets
  - Savings Effect of Mass Media Campaigns

- There are lessons from other drought periods/areas
  - A summary to follow

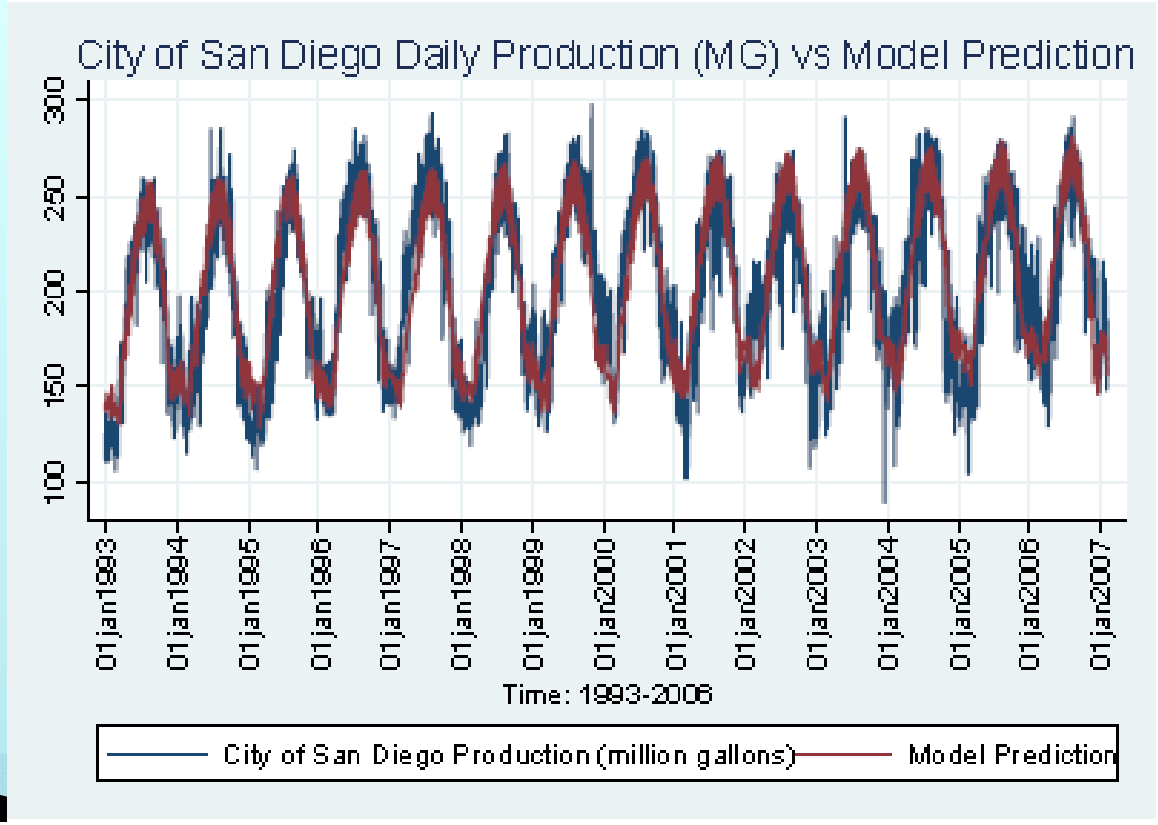
# Pure Persuasion

- So. California Mass Media Campaigns
  - Did they have any effect on water demand?
- Statistical Intervention Analysis of Daily Demand Data
- Can we detect any drop in demand during and immediately following time periods of intensive media campaigns with conservation messages?

# Effect of Media Campaigns—Statistical Intervention Analysis

- City of San Diego Daily Water Demand showed a measurable effect of media, 2004-2006
- About 5,700 AF of demand reduced over the three year period
- Direct costs:

  < $100 AF
- Does not include customer shortage costs



# Non-Price-Induced Water Conservation

During drought, many things happen as once

- Drought pricing adjustments
- Public relations efforts that affect water use behaviors
- Public awareness
- Level of programmatic activity/enforcement by agencies
- Water use restrictions

During drought, customers have limits to cut back.

- Some water not "discretionary" (e.g., sanitary use)
- Some water exempt from restrictions (fire, erosion control)
- Some water used indoors (restrictions focus on outdoor use)

# Drought Programs and Persuation: Goals and Achievements

Table 3 Programs Adopted by Retail Water Suppliers during California Drought 1976-77

| Supplier | Residential Rationing Program | Achievement, percent |
|---|---|---|
| Marin Municipal Water District | Mandatory 57 percent per capita | 65 |
| East Bay Municipal Utility District | Mandatory 35 percent per household | 40 |
| Contra Costa County Water District | Mandatory 30 percent | 25 |
| San Francisco Water Department | Mandatory 25 percent | 30 |
| Los Angeles DWP | Mandatory 10 percent | 16 |
| Sunnyvale Water Department | Voluntary 25 percent | 26 |
| Santa Clara Valley Water District | Voluntary 25 percent | 30 |
| City of Pleasanton | No program | 19 |

Source: Reproduced from "2007 Updated Edition, Draft Urban Drought Guidebook" State of California Department of Water Resources, Office of Water Use Efficiency and Transfers, August 2007

# Synergies: Programs and Persuasion

- What is the effect of providing education to customers on efficient watering practices?
- What is the effect of combining efficient irrigation controllers with customer information?
- Example from the Residential Runoff Reduction (R3) study in Orange County

# Statistical Models of Water Savings—Delta Change in Customer Consumption

- Deterministic functions of calendar time, including
  - The seasonal shape of demand
- Weather conditions
  - measures of air temperature
  - measures of precipitation, contemporaneous and lagged
- Customer-specific mean water consumption
- "Intervention" measures of the date of participation and the type of intervention

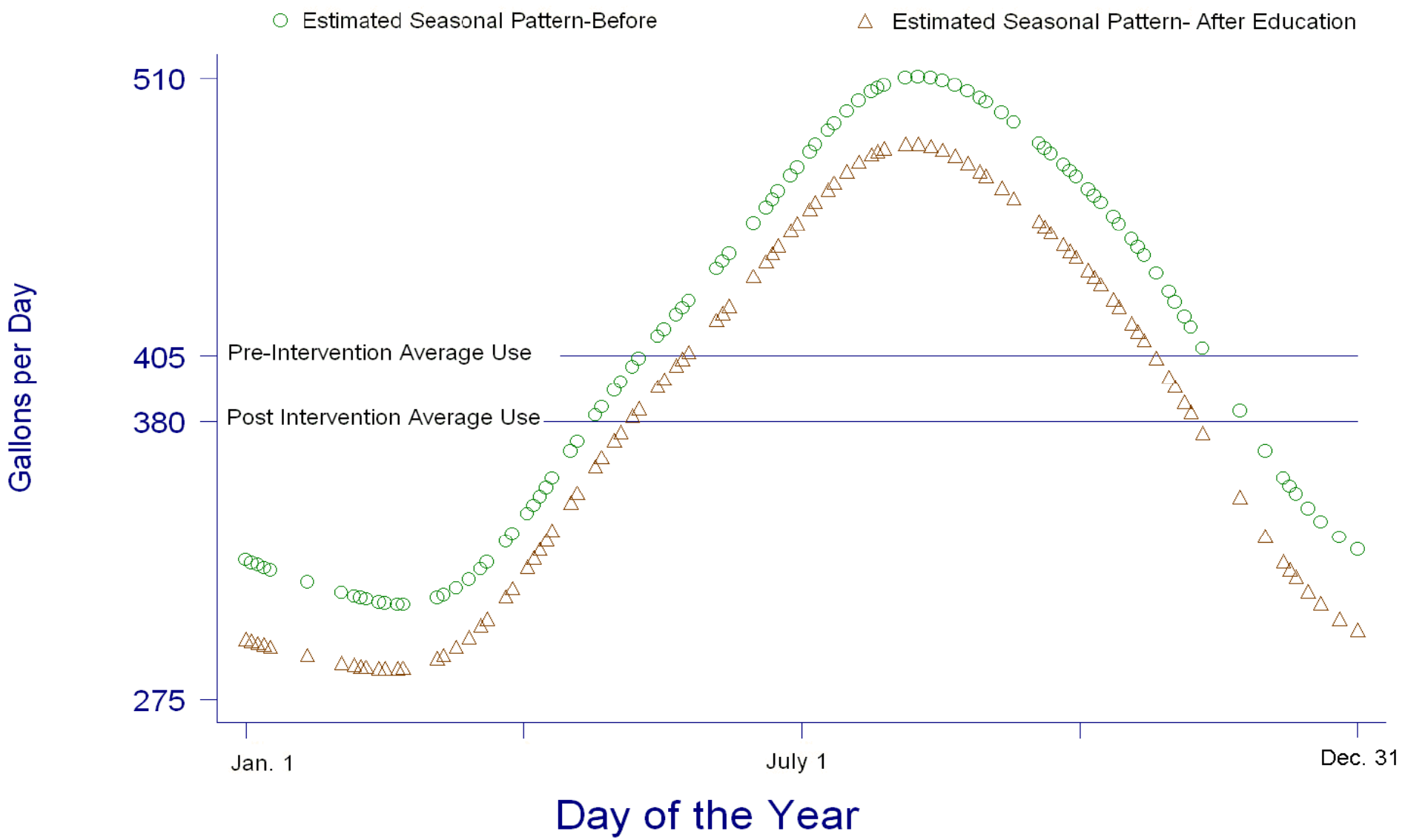
# Statistical Model

$$Use = \mu_i + S_t + W_t + E_{i,t}$$

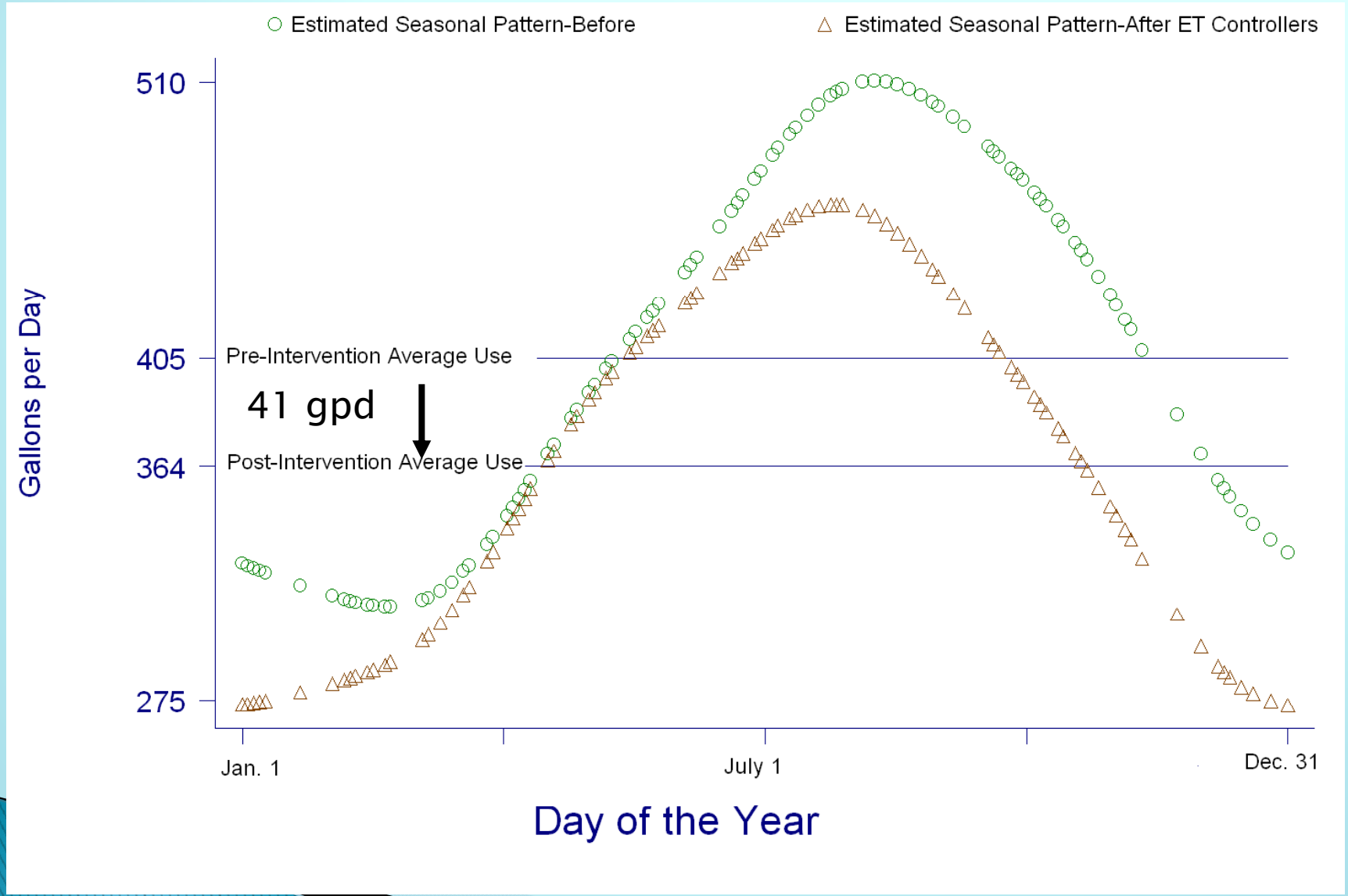
- $\mu_i$ represents mean water consumption per meter *i*,
- $S_t$ is a seasonal component,
- $W_t$ is the weather component,
- $E_{i,t}$ is the effect the landscape interventions for meter *i* at time period *t*.

$$E_{i,t} \equiv I_{ET} \cdot \beta_{ET} + I_{Ed} \cdot \beta_{Ed}$$

# Model Results-Education Only: 25gpd



# Model Results–ET/education: 41 gpd mean



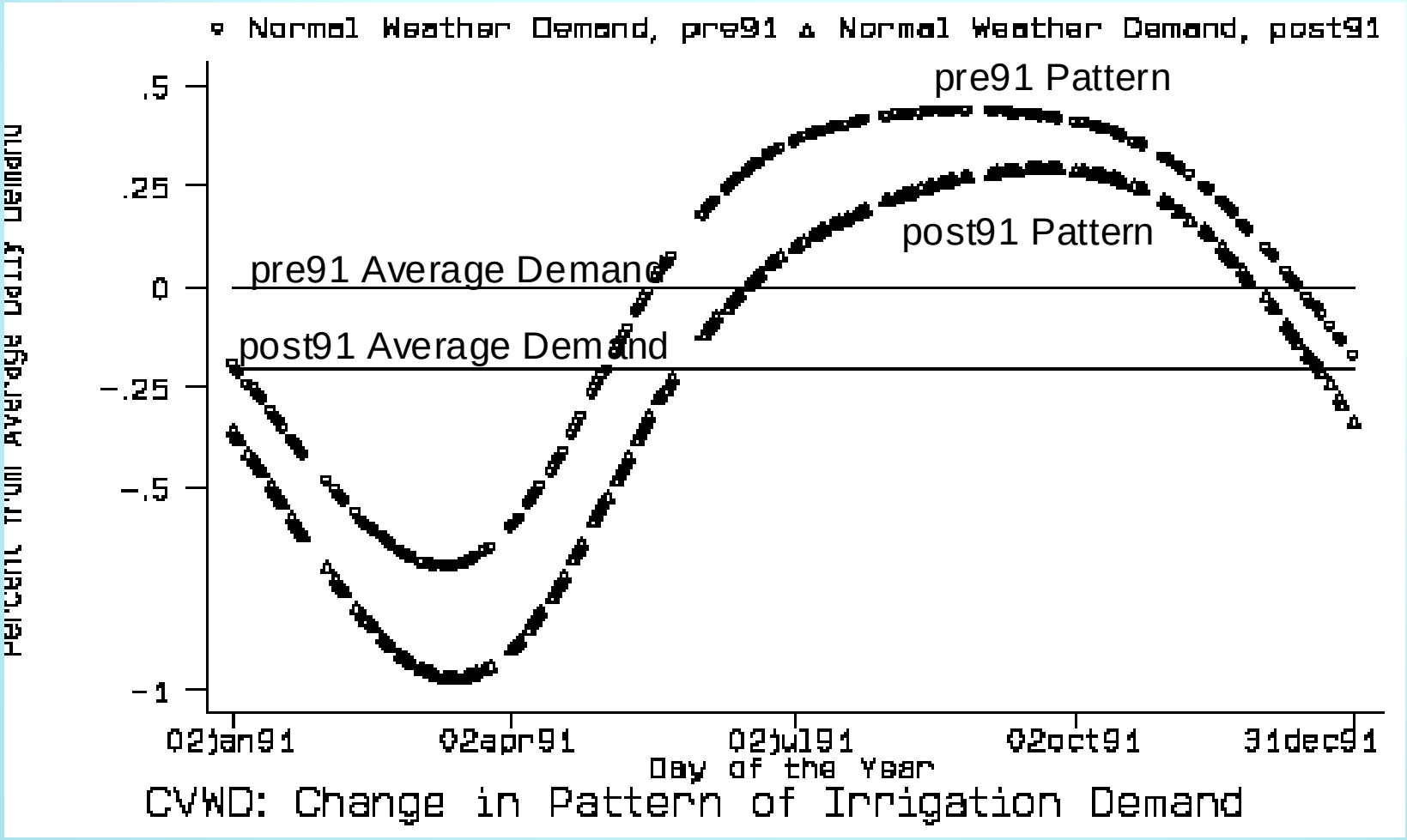
# Big Synergy: Prices, Programs, and Persuasion: Water Budget-based Rates with Outreach

## Pre-/Post- Consumption Comparison

### Irrigation Rate (inches/acre)

| Period | Otay | Irvine | Capistrano Valley |
|---|---|---|---|
| pre '88-'90 Average | 28.71 | 52.16 | 28.35 |
| post '90 Average | 23.05 | 32.78 | 18.45 |
| Difference | -5.66 | -19.38 | -9.90 |
| Percent Change | -20% | -37% | -35% |

# Statistical Impact Evaluation: Change in Irrigation Demand



# Prices, Programs, and Persuasion

- The question is not "**either/or**". You need **all** three:
- Prices:
  - If prices are too low, customers will under-invest in water efficient technologies and practices.
  - If prices are too high, customers will not derive desirable benefits from water use.
- Programs — Can deliver proven water efficiency to customers at lower cost
- Persuasion:
  - Does work during emergencies.
  - Persistence of behavioral change is the issue.
  - Persuasion without price is insufficient.
  - Communication with customers will be key to bringing about efficient water use.

# Conjuctional Advice

- Avoid "**either**" Price Programs Persuasion **"or"** Price Programs Persuasion
- Use "**and**" as in:
  - Effective Persuasion (marketing and education)
  - Cost-effective WUE Programs, **and**
  - Efficient Pricing

# Prices, Programs, and Persuasion

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