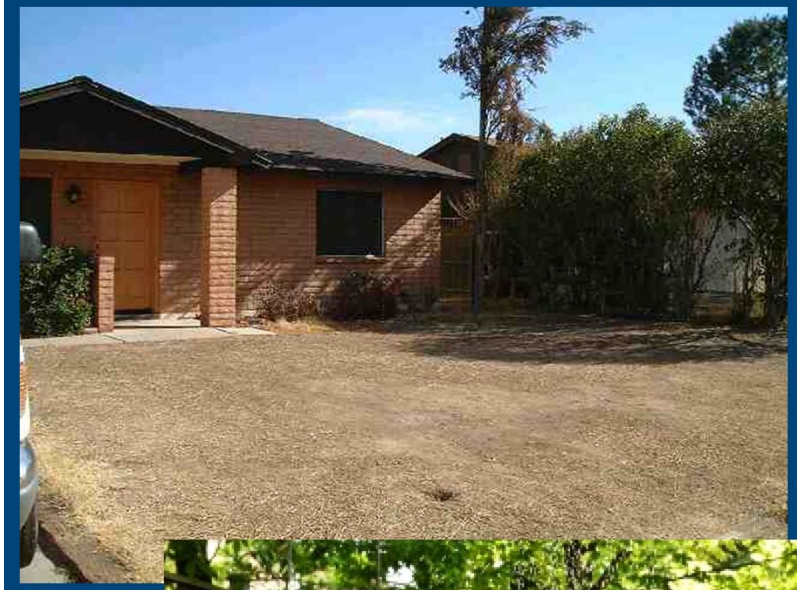

The Economics of Water Supply Reliability

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Boulder, CO

WSAC Meeting
Santa Cruz, CA
Sept 26, 2014

Valuing Water Supply Reliability

- What does “reliability” mean?
- How does it apply in the residential sector?
- How does it apply in the business sectors?
- What do we know about the economic value of water supply reliability?
- What can we do for Santa Cruz to inform the deliberations?

What is Water Supply Reliability?

"The ability of a water supply option to produce a given yield on a reasonably stable, continuous basis, whenever the utility wishes to tap and operate that given source."

Dimensions of Reliability

- ***Periodic adverse events***
  - *i.e., droughts, associated water use restrictions*
- *Episodic, catastrophic events*
  - *e.g., earthquakes*
  - low probability, high consequence risk
- *Quasi-routine inconvenient events*
  - *i.e., infrastructure repairs*
  - moderate probability, low consequence risk

Measures of Reliability

- Frequency and severity of shortfalls
- E.g., the water supply portfolio provides at least 90% of demands, at least 95% of the time
- Portfolio theory – diversify risks

Values of Reliability

- Willingness to Pay
- Direct business losses
  - Employment, income, tax revenues
- Secondary economic impacts
  - “Multiplier effects” (indirect, induced)
  - Regional economic models (e.g., IMPLAN)

Residential Customers

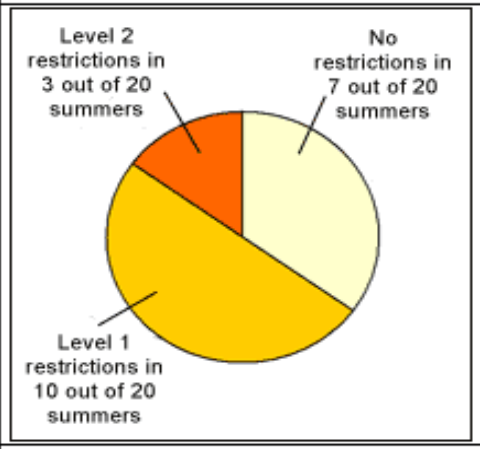
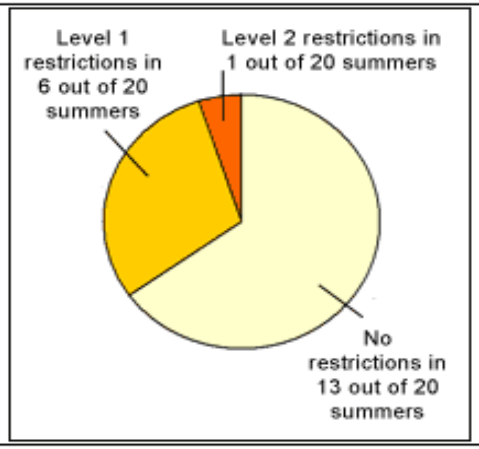
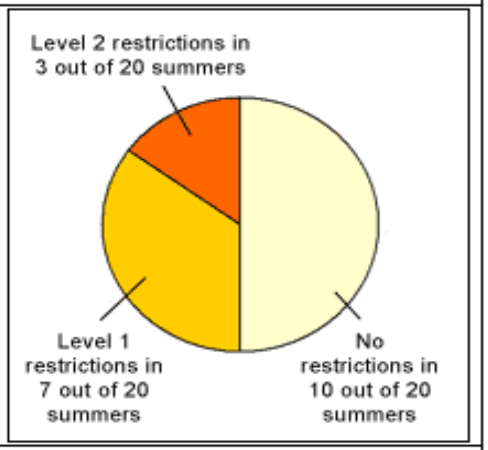
- Econometric Demand Modeling
  - Demand curve provides metric of lost economic welfare
- Stated Preference
  - Scientific survey methods
  - *Value of Water Supply Reliability in the Residential Sector (2011);* WRRF-08-09

Recent study of over 2100 households

- "Stated preference" survey of customers
  - Austin, TX
  - Long Beach, CA
  - Orlando, FL
  - San Francisco, CA
  - Utility "X"

Survey Components:
Three Stated Choice Experiments

This table presents some additional plans with different levels of expected future water use restrictions in the next 20 years at different costs to you. Please review the table and check the box under the plan you most prefer.

	No Additional Actions	**Plan D**	**Plan E**
Available water supply such that water use restrictions in the next 20 years will be:			
Increase in your water cost	$1 per month, which would be $12 per year	$18 per month, which would be $220 per year	$5 per month, which would be $55 per year
Which plan do you prefer?	○	○	○

Next

Results: Annual Household Willingness to Pay (per year avoided)

2010 $s

	Austin	Long Beach	Orlando	San Francisco	Utility X
WTP to reduce Level 1 restrictions by one year				$12.25	
WTP to reduce Level 2 restrictions by one year	$33.94	$34.29	$20.20	$37.16	$20.55

Summary of Residential Results

- Customers are willing to accept mild water use restrictions
- Customers are willing to pay to avoid severe restrictions
  - Annual WTP to avoid these restrictions = $20 to $37 per household per year, for each year of Level 2 restrictions avoided

Applying the Empirical $ Value Results

- Example
  - Option would reduce the number of Stage 2 restrictions by ***3 years***
  - You serve ***25,000 households***
  - Lower end of range: ***$1.5 million per year***
  - 25,000 HH x $20/HH/yr X 3 years = $1.5 million

Another Perspective . . .

Interpreting WTP estimates in terms of $/AF

Assumptions

WTP Orlando = $20.20 per household

Water use reduction from Stage 1 to Stage 2 restrictions = 15%

Water use for homes with a yard = 325 gallons per day or 36% of an AF per year

Calculations

15% reduction under Stage 2 restrictions = **5.4% of AF** (15% × 36% of an AF)

WTP of $20.20 each year for 20 years has a **present value of $250**, when discounted at 6%

→

WTP to avoid losing use of **0.054 AF** in one future year = **$250**

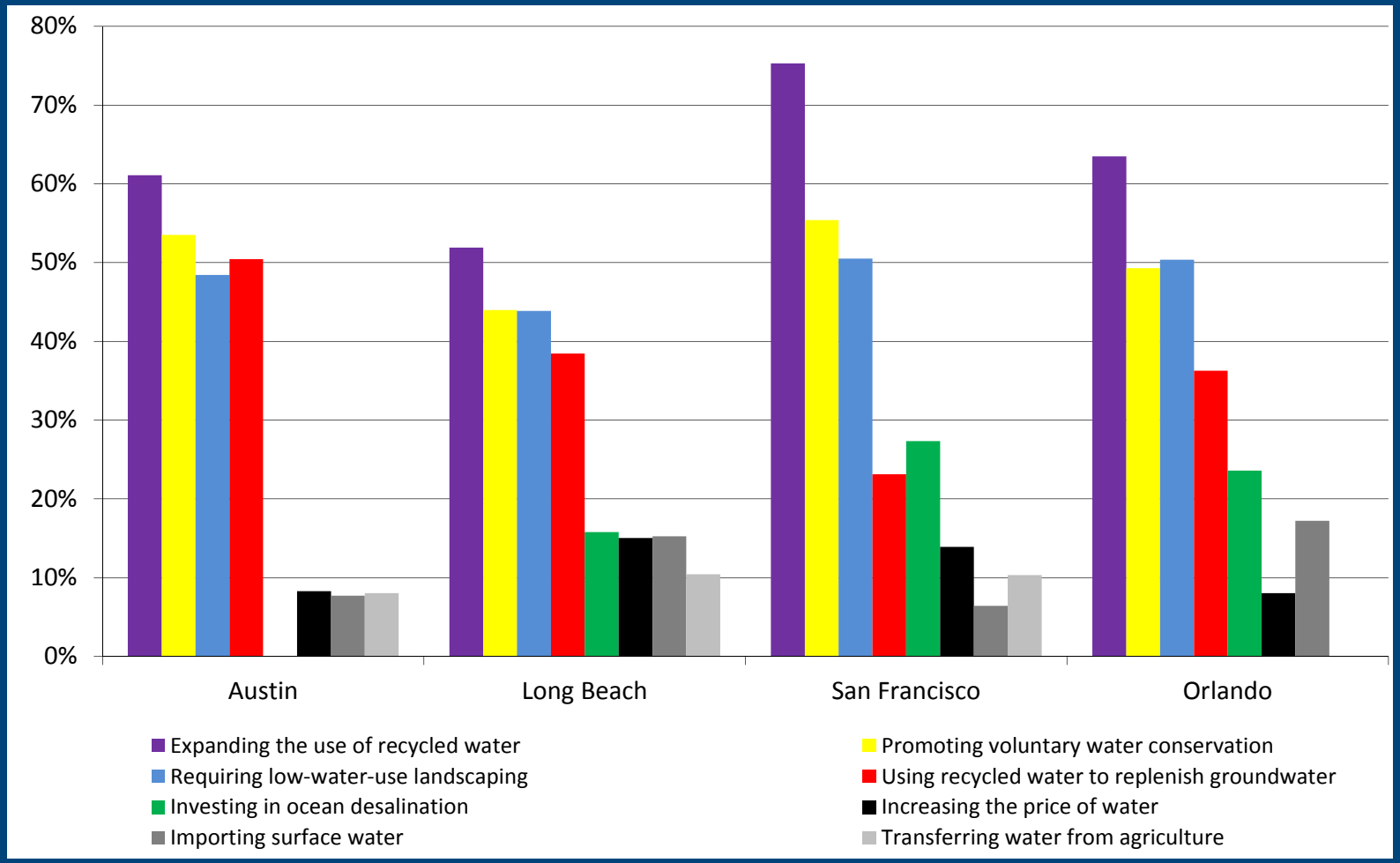
→

Value to household for that water use = **$4,630 per AF** (= $250/0.054 AF)

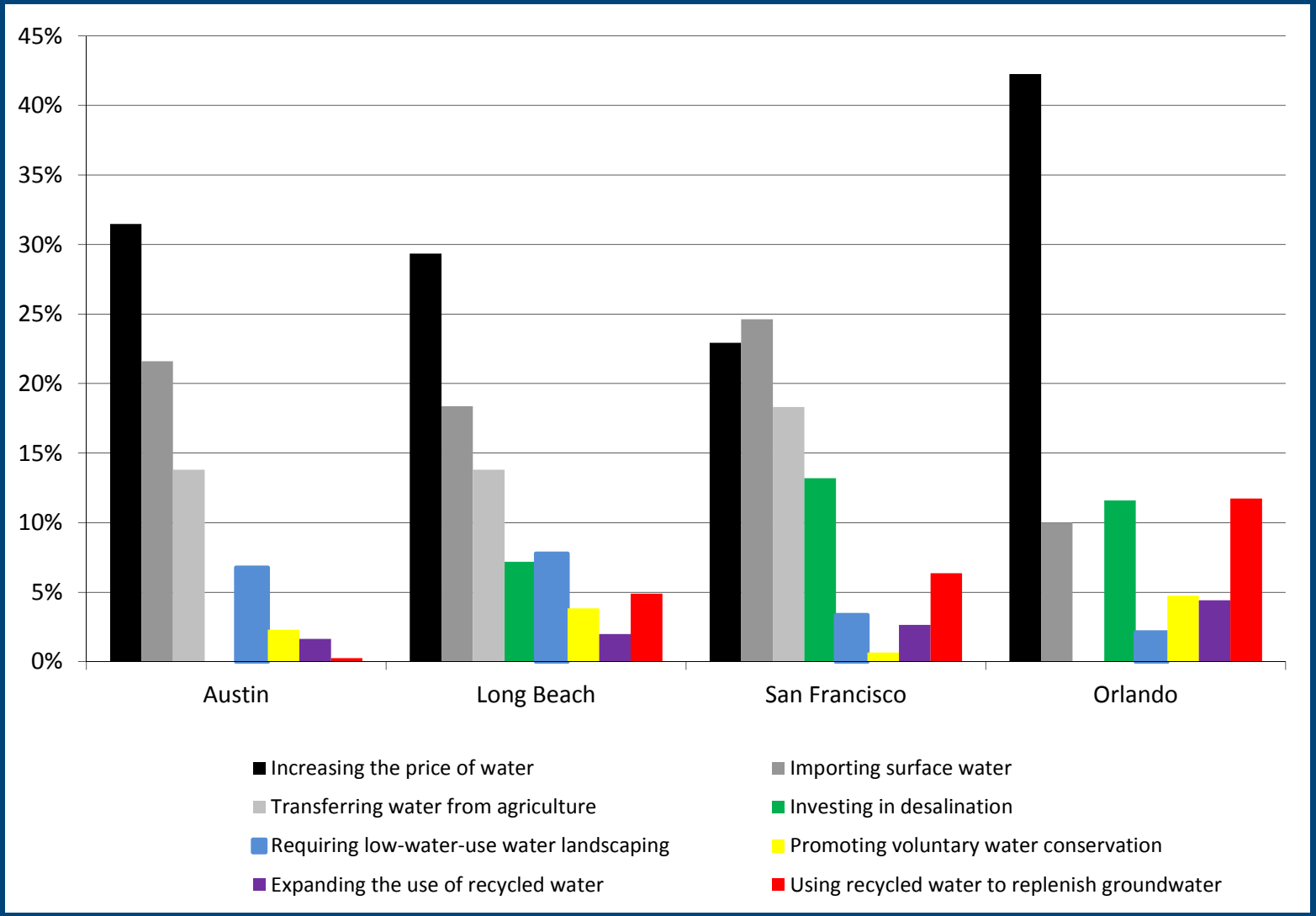
Water Supply Option Preferences

- Respondents ranked 9 to 10 water supply options
  - Transferring water from agriculture
  - Importing (more) surface water
  - Expanding/adding surface reservoirs (storage)
  - Increasing the price of water
  - Requiring low-water-use landscaping
  - Promoting voluntary water conservation
  - Expanding use of recycled water for irrigation and industrial purposes (NPR)
  - Water recycling to replenish groundwater (IPR)
  - Regional desal facilities

Percentage of Respondents Choosing a Given Option as One of Their Three Most Preferred Options



Least Preferred Options



Business and Regional Economic Impacts

- WateReuse Research Foundation (WRRF-09-04)
  - In publication
- Commercial, Industrial, and Institutional (CII) customers

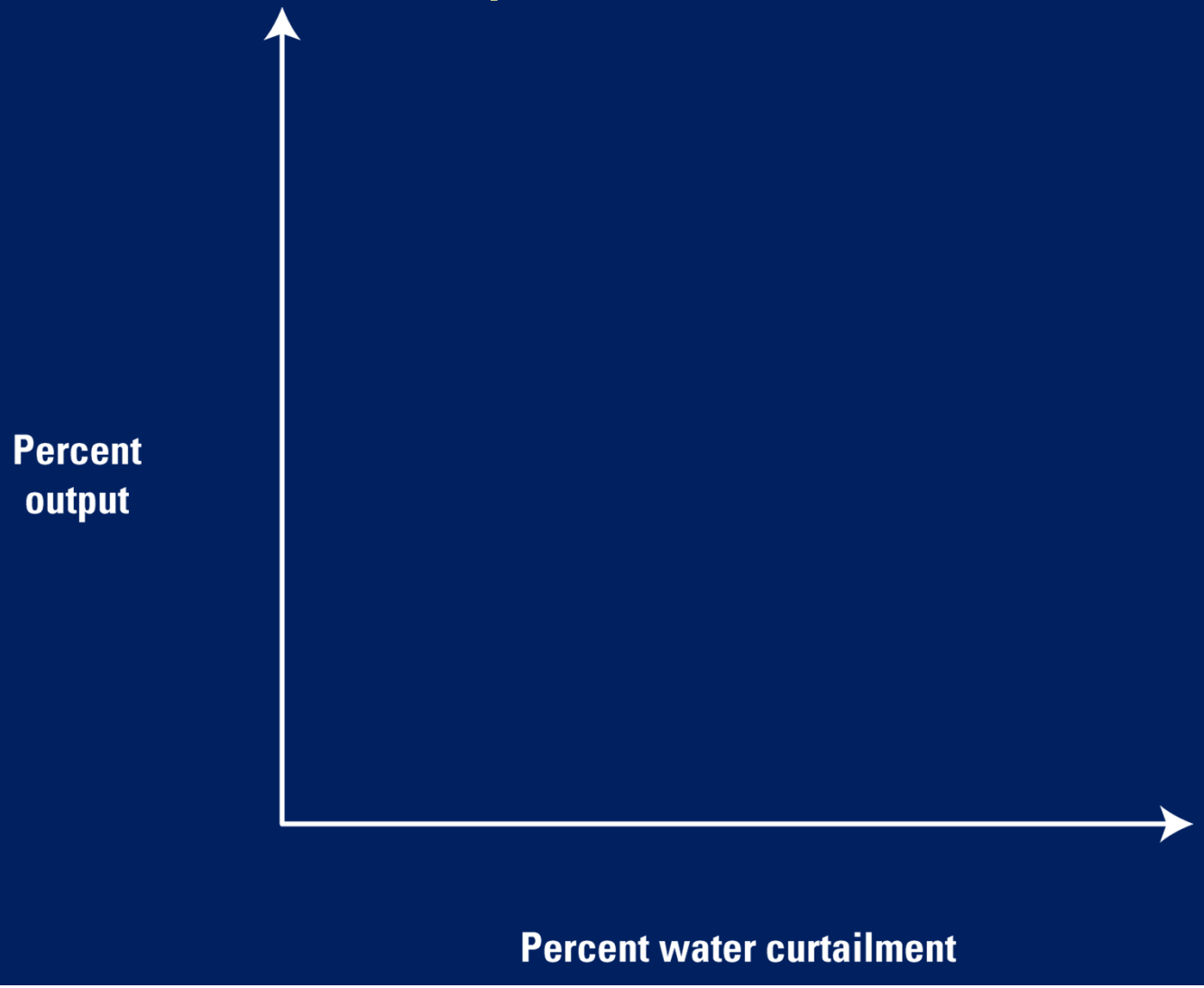
A Vital Symbiotic Relationship

- CII entities rely on a reliable water supply to operate viable, profitable businesses
- Communities rely on CII businesses to provide jobs, stimulate regional economic vitality, generate tax revenues, etc.
- Water providers are the crucial linchpin through which this symbiotic relationship functions

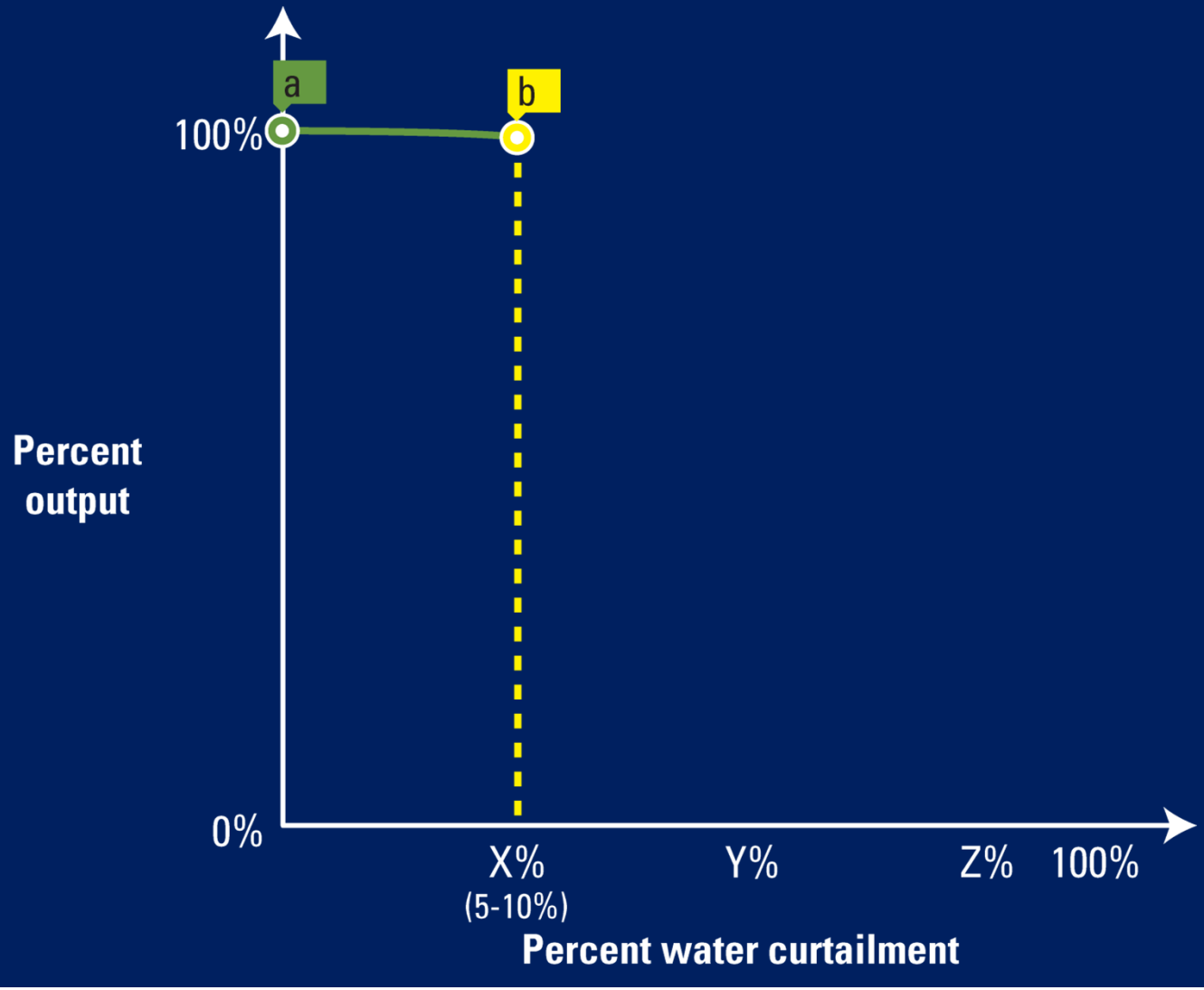
Little Known about CII Water Use

- Who uses how much water?
  - When, and for what purposes?
  - How much variation across CII sectors?
- How much *value added* is provided by water?
  - Employment and local economic impacts
  - Output and profits for business entities
- How sensitive are CII entities to possible shortages and supply disruptions?
  - What is the full cost of shortfalls, disruptions?
  - What is the value of water supply reliability?

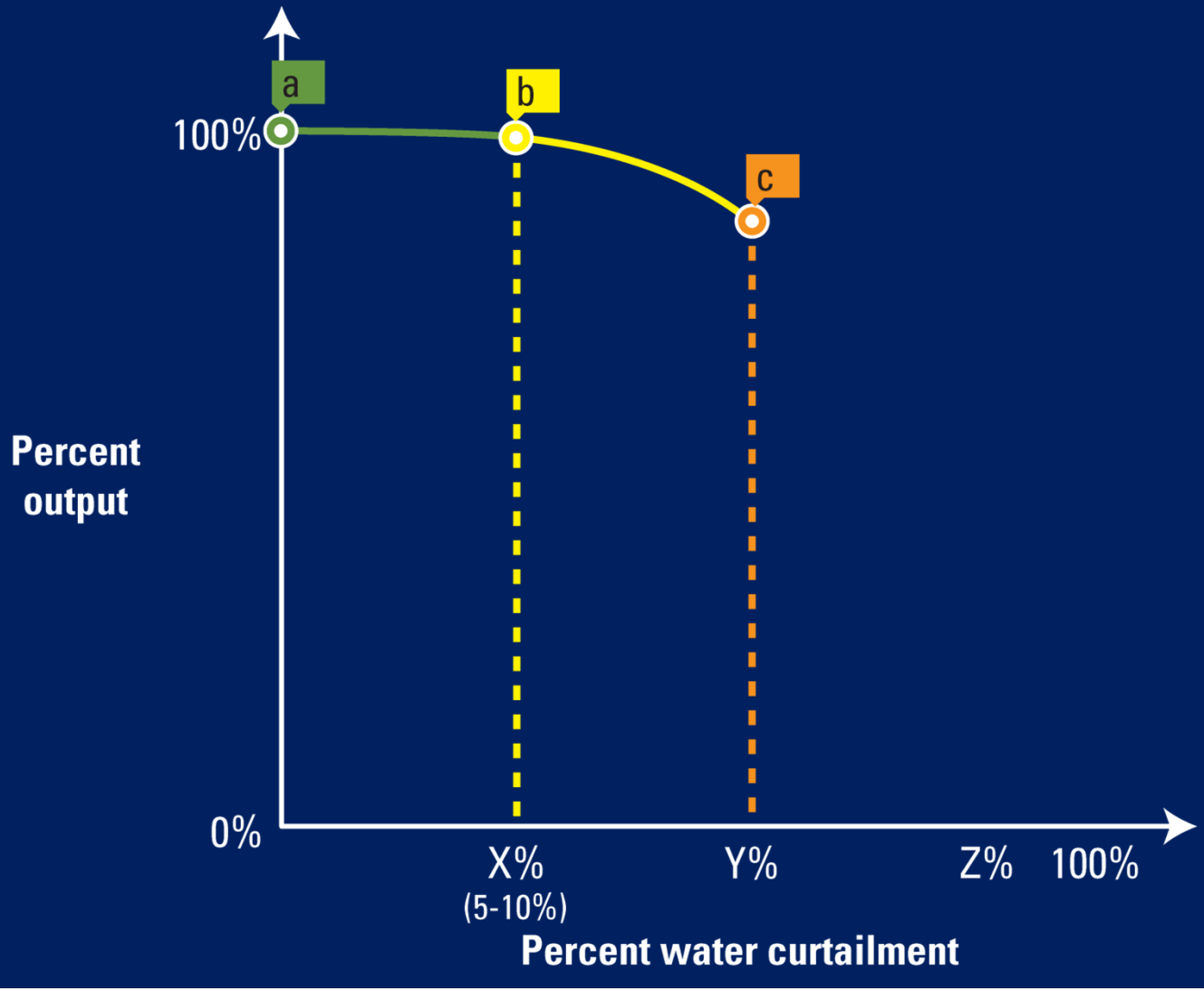
Water Supply Curtailment and Business Output



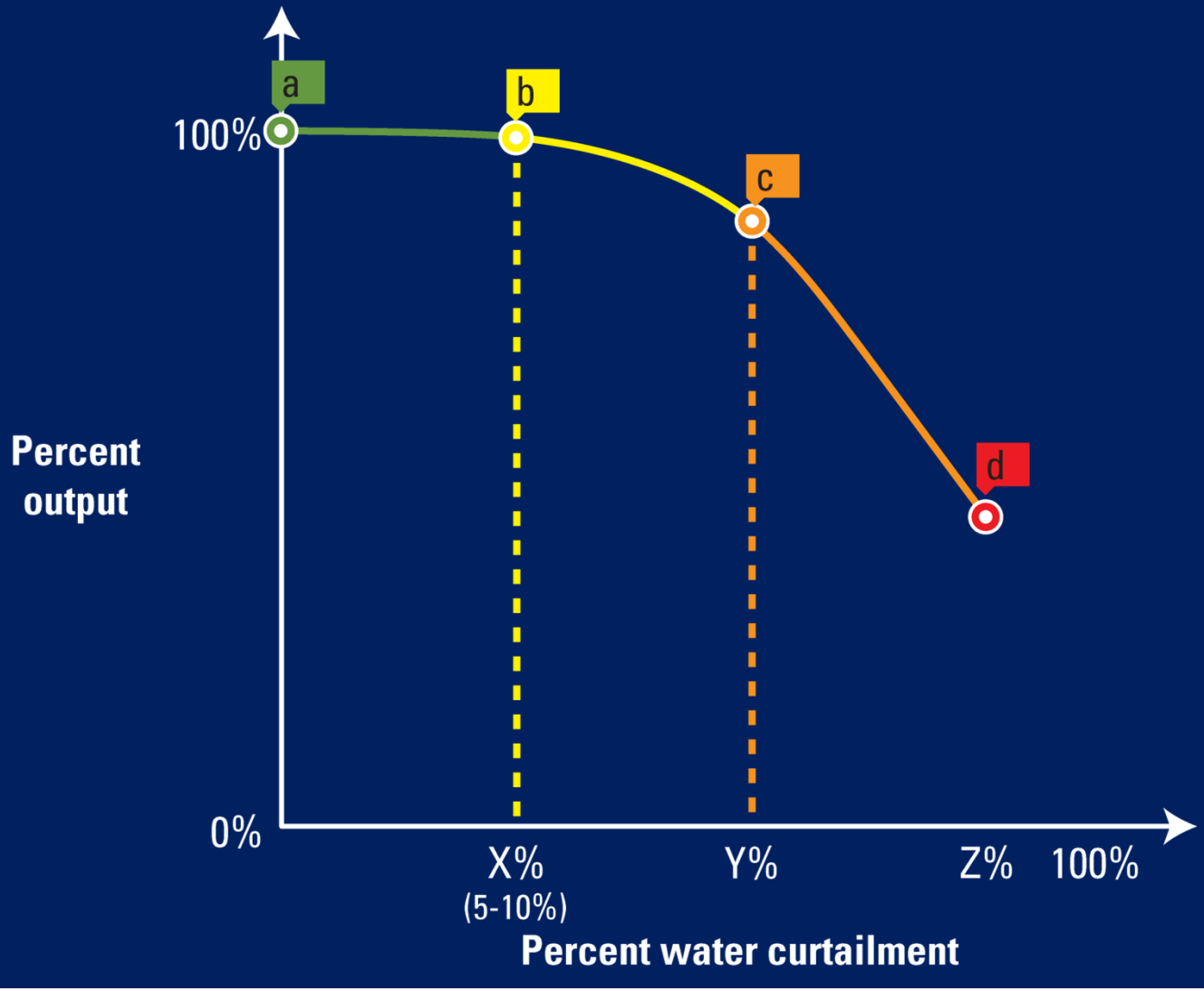
Water Supply Curtailment and Business Output (cont.) not to scale



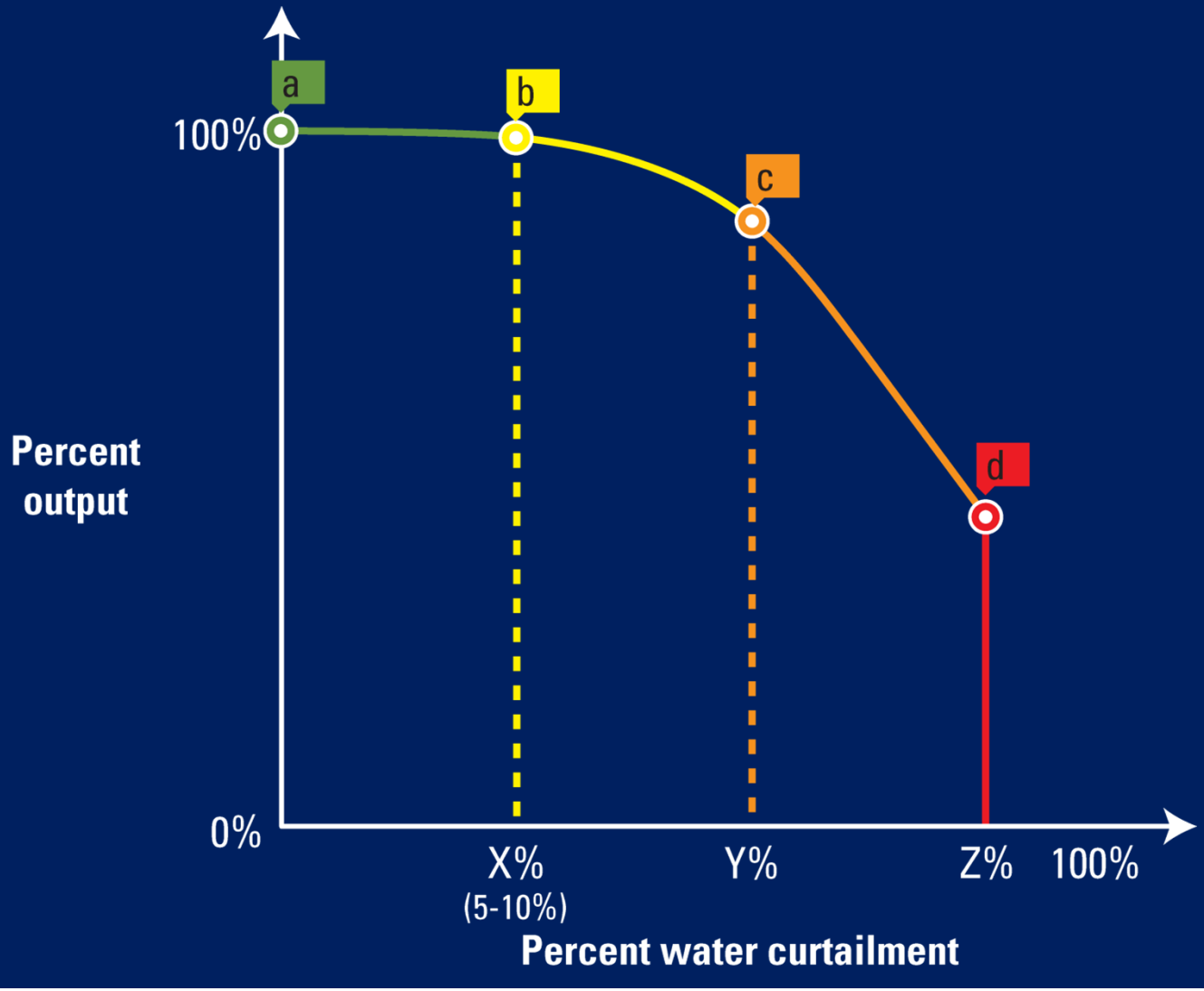
Water Supply Curtailment and Business Output (cont.)



Water Supply Curtailment and Business Output (cont.)



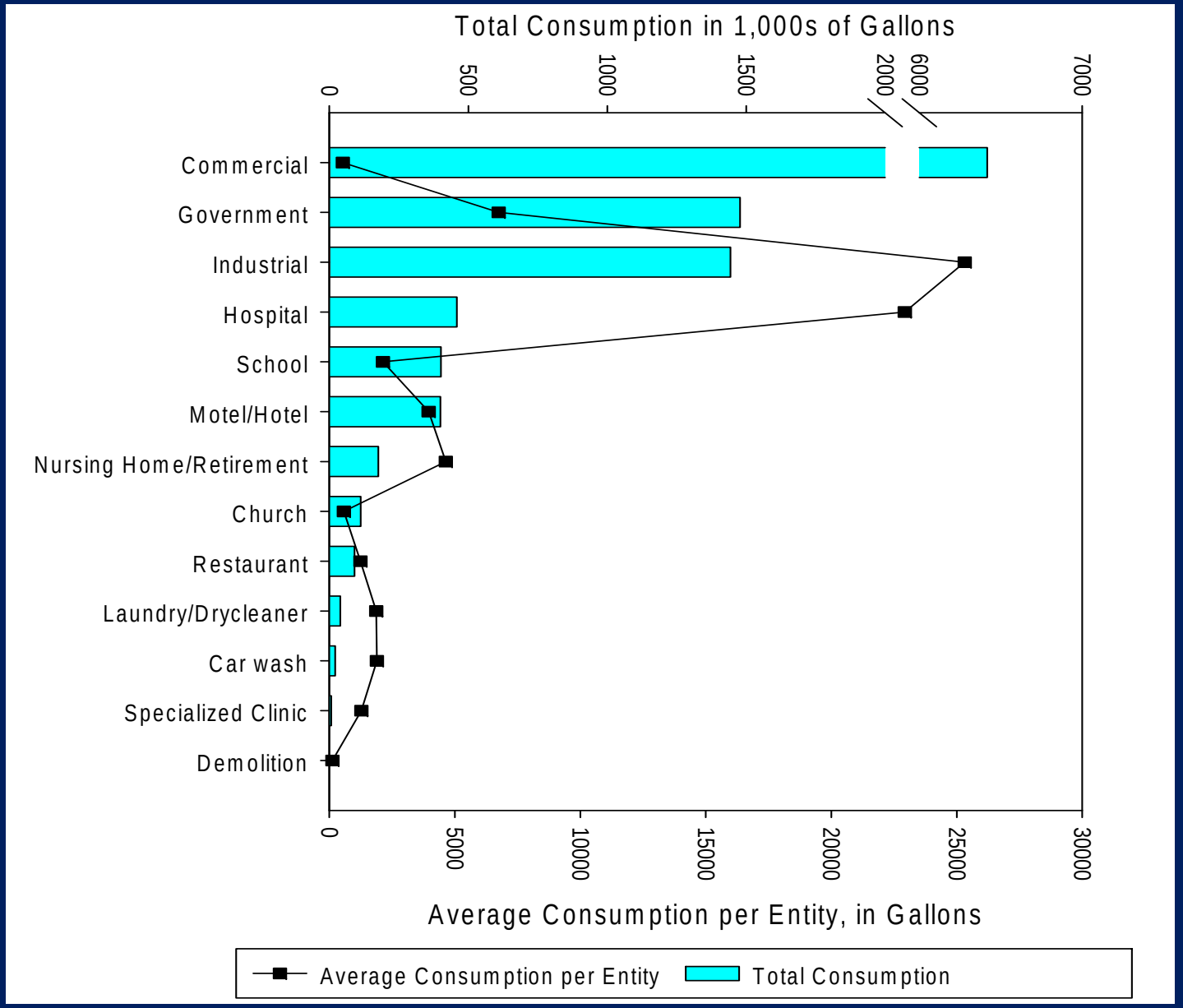
Water Supply Curtailment and Business Output (cont.)



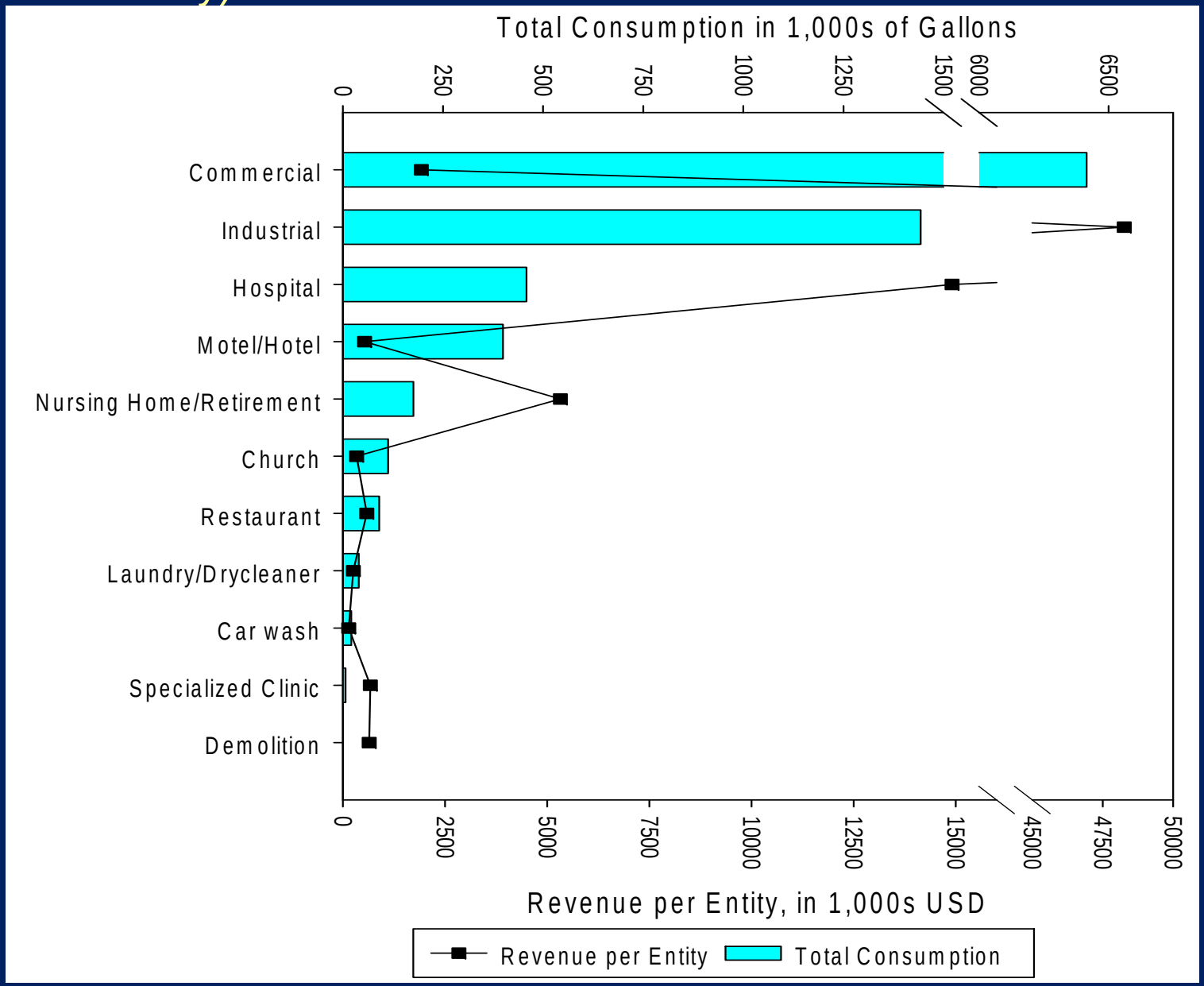
Basic Approach

- Obtain and evaluate water use patterns in CII sectors in service area
  - Based on billing system data from Water Dept
  - Identify large volume users and sectors
- Obtain economic data on businesses in area
  - Based on US Economic Census and NexisLexis
  - Match to water use data by sectors, by SIC or NAICS codes, where feasible

Sector Annual Total and Per Account Average Monthly Water Use
(Midwest Utility)



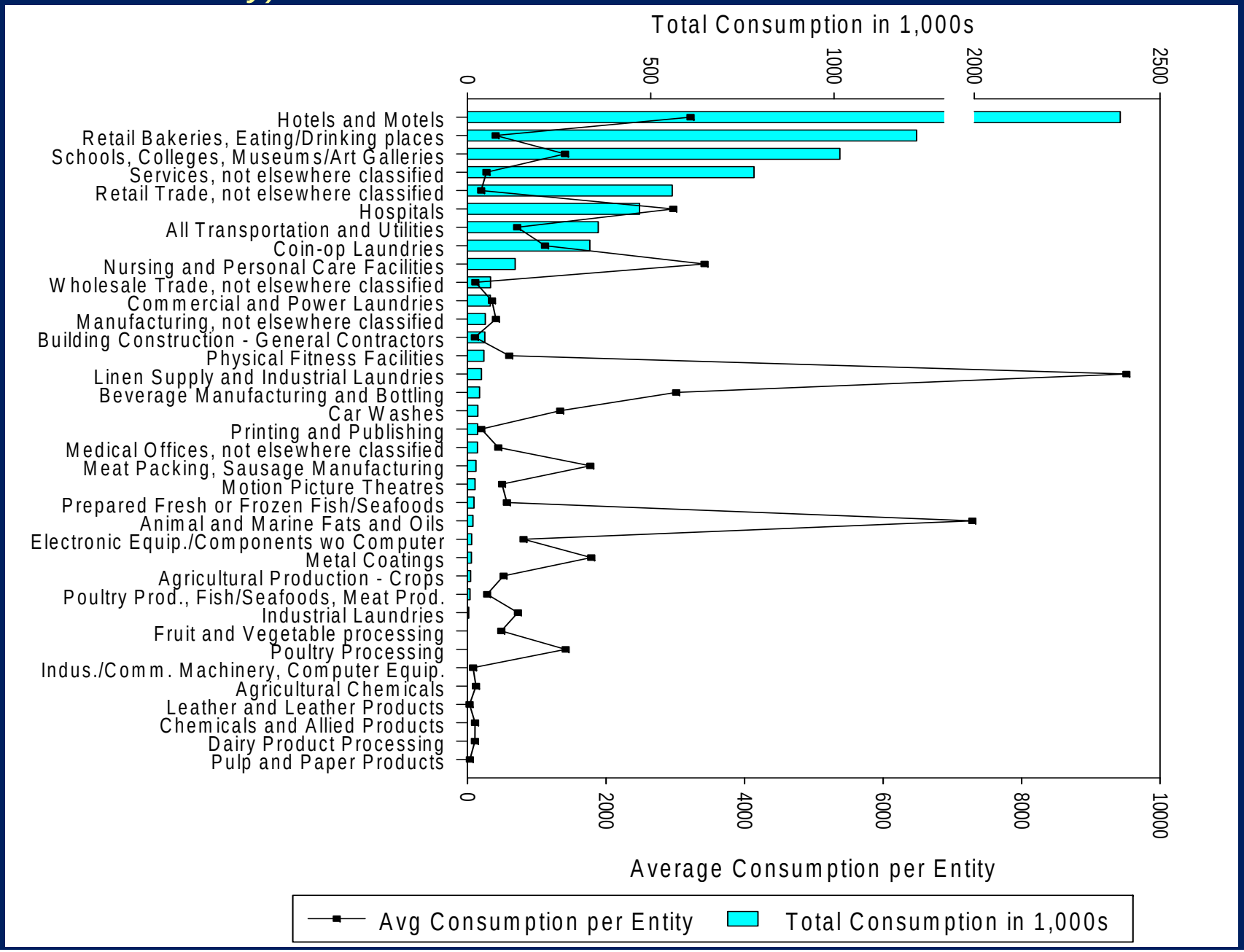
Total Consumption and Revenue Per Entity
(Midwest Utility)



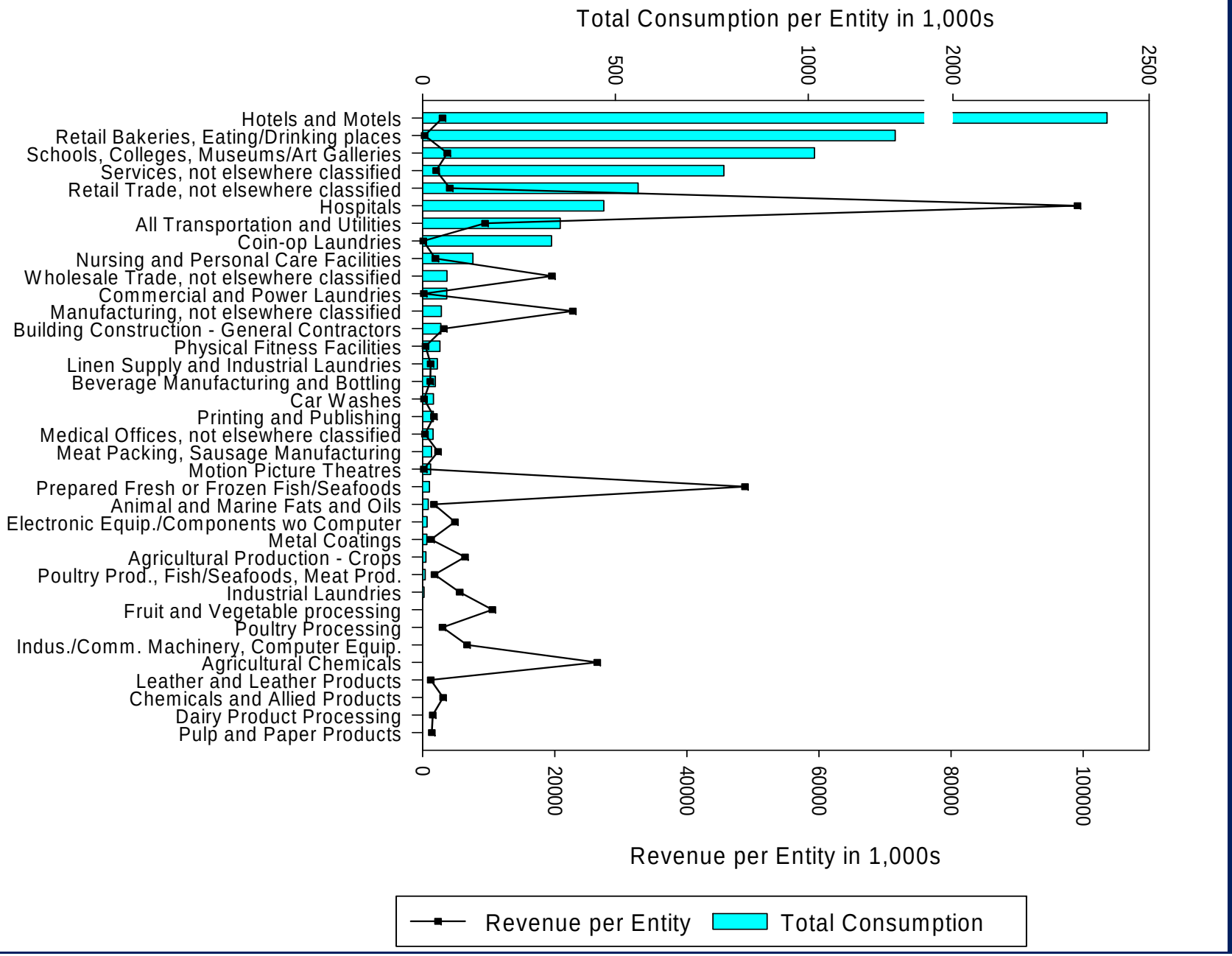
Sectors with Large Overall Water Use

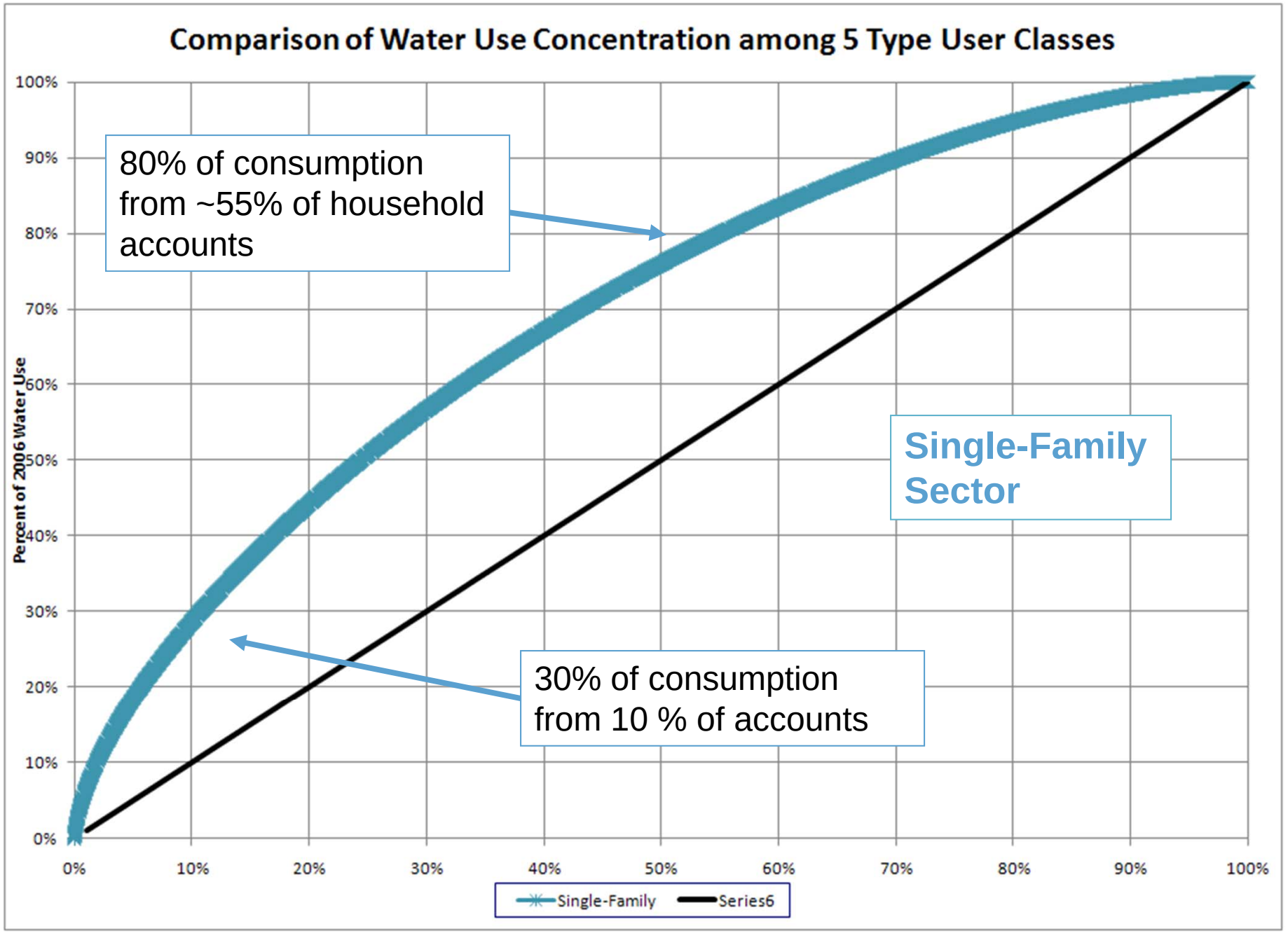
- Industrial manufacturers
- Hospitals, nursing homes, personal care, medical providers
- Laundries (commercial, linens, industrial)
- Hotels (especially with restaurants, gardens, pools, etc.)
- Food processors

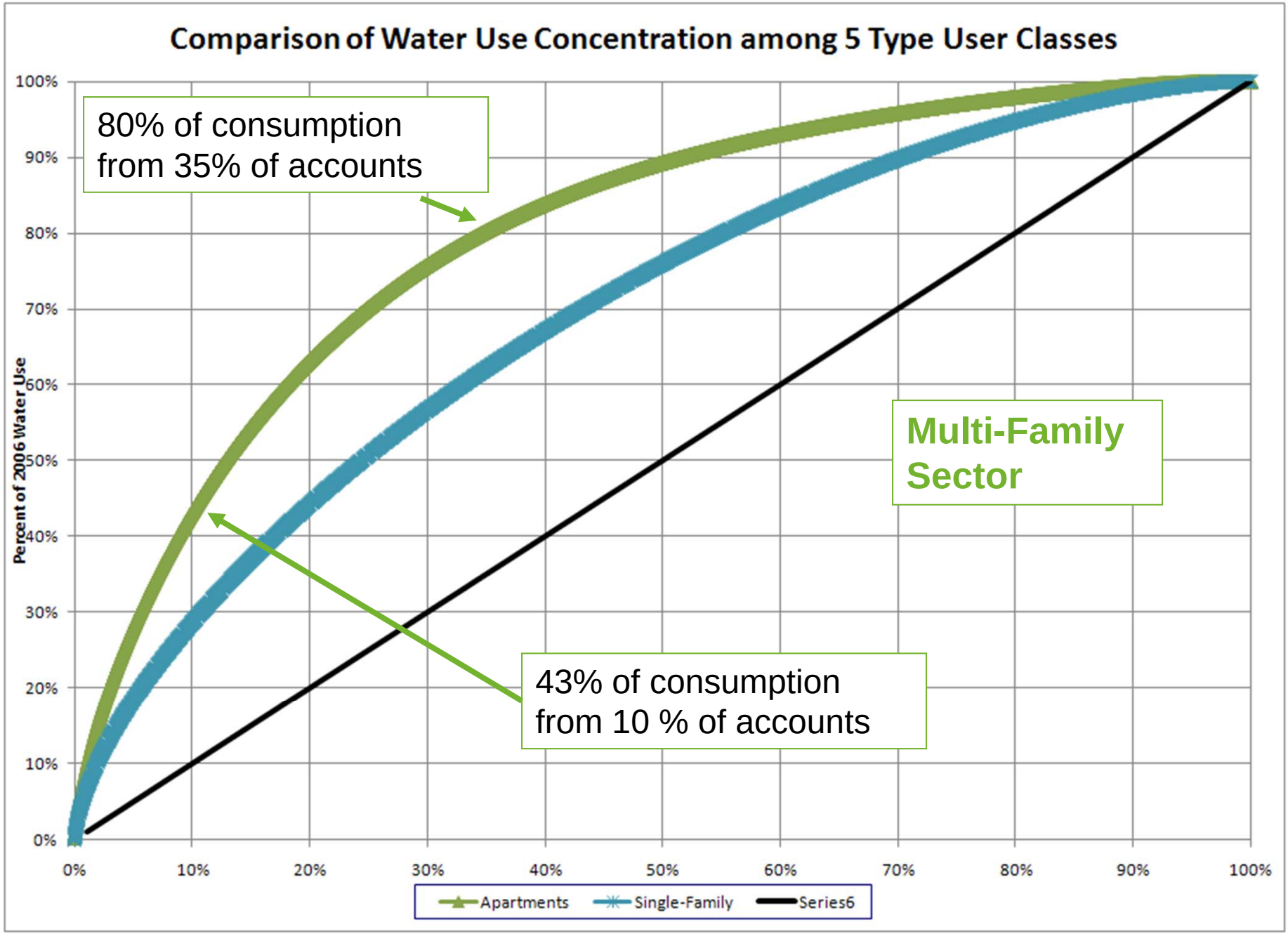
Sector Annual Total and Per Account Average Monthly Water Use
(West Coast Utility)

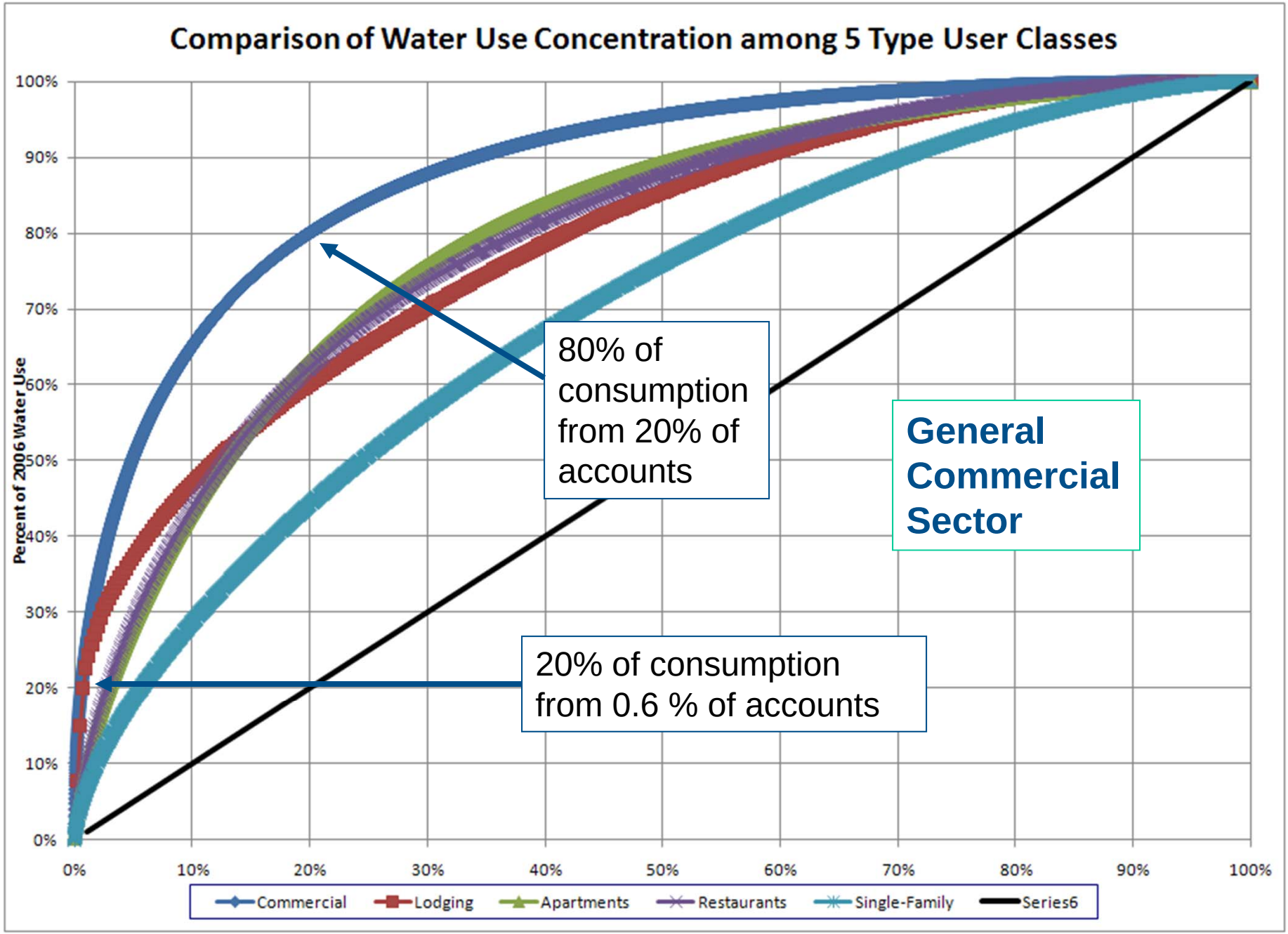


Total Consumption and Revenue Per Entity (West Coast Utility)




Comparison of Water Use Concentration among 5 Type User Classes
Percent of 2006 Water Use
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Single-Family
Series6
80% of consumption from ~55% of household accounts
30% of consumption from 10 % of accounts
Single-Family Sector


Comparison of Water Use Concentration among 5 Type User Classes
80% of consumption
from 35% of accounts
Multi-Family
Sector
43% of consumption
from 10 % of accounts
Percent of 2006 Water Use
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Apartments
Single-Family
Series6


Comparison of Water Use Concentration among 5 Type User Classes
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100%
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50%
40%
30%
20%
10%
0%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
80% of consumption from 20% of accounts
General Commercial Sector
20% of consumption from 0.6 % of accounts
Commercial
Lodging
Apartments
Restaurants
Single-Family
Series6

Regional Economic Impacts

- Input-Output models linking impacts across sectors
  - Multiplier and cross-sectorial effects
- Fairly easy to access and run…
- But need to estimate direct impacts to feed into the model

Some of Dave Mitchell's work on Economic Impacts at EBMUD

Table 4.2. Customer Class Water Shortages and Water Shortage Costs for EBMUD

	Water Shortage Cost		
	Million $ per Year of Shortage		
Rationing Level	**10%**	**15%**	**25%**
Single family	24.2	47.5	150.7
Multifamily	6.4	12.1	34.2
Commercial	94.5	142.3	786.2
Industrial	57.7	86.8	145.1
Institutional	0.5	0.8	1.7
Irrigation	2.6	5.6	24.6
Total	**186.0**	**295.1**	**1142.5**

Notes: Water shortage cost = consumer surplus losses for residential, institutional, and irrigation customer classes plus regional value added losses for CI customer classes. Regional value added losses equal the sum of losses to labor income, proprietor income, profits and property income, and indirect business taxes.

Customer class water shortages and water shortage costs for EBMUD are based on 2040 level of development.

Source: M. Cubed, 2008b.

nomic Impacts per Year of Water Shortage for EBMUD

	Rationing Level: 10%			Rationing Level: 15%			Rationing Level: 25%		
	Commercial	Industrial	Total	Commercial	Industrial	Total	Commercial	Industrial	Total
	318	472	790	479	710	1188	5745	1186	6931
	16.2	33.0	49.2	24.4	49.7	74.1	292.8	83.0	375.8
	94.5	57.7	152.2	142.3	86.8	229.1	786.2	145.1	931.3
	131.2	147.4	278.6	197.5	221.8	419.3	1091.0	370.7	1461.7

ortages and water shortage costs for EBMUD are based on 2040 level of development.

Table 4.3. Regional Economic Impacts per Year of Water Shortage for EBMUD

	Rationing Level: 10%			Rationing Level: 15%			Rationing Level: 25%		
Economic Indicator	**Commercial**	**Industrial**	**Total**	**Commercial**	**Industrial**	**Total**	**Commercial**	**Industrial**	**Total**
Employment (jobs)	318	472	790	479	710	1188	5745	1186	6931
Payroll (million $)	16.2	33.0	49.2	24.4	49.7	74.1	292.8	83.0	375.8
Value added (million $)	94.5	57.7	152.2	142.3	86.8	229.1	786.2	145.1	931.3
Output (million $)	131.2	147.4	278.6	197.5	221.8	419.3	1091.0	370.7	1461.7

Note: Customer class water shortages and water shortage costs for EBMUD are based on 2040 level of development.

Source: M. Cubed, 2008b.

What Can we Do in Santa Cruz?

- Residential
  - Survey of households
  - Econometric demand modeling
- CII
  - On-going roundtables, interviews, etc.
  - Examine billing data base – sectorial insights
  - Overlay economic data (Nexis-Lexis, etc.)
  - Water intensity metrics (e.g., jobs/MG)
  - Regional economic impact model runs