



# Urban Water Demand Roundtable February 9-10, 2015

## Research Considerations for Evaluating Water Use among CII Sectors

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**HAZEN AND SAWYER**  
Environmental Engineers & Scientists

# Importance of the CII Sector

- CII consumption typically 30-50% of utility water use
- Business sector providing jobs and incomes
- Source of migratory (“non-resident”) demands
  - Employment
  - Tourism
- Critical social infrastructure



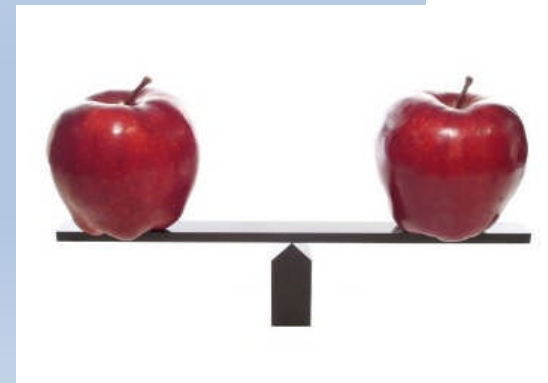
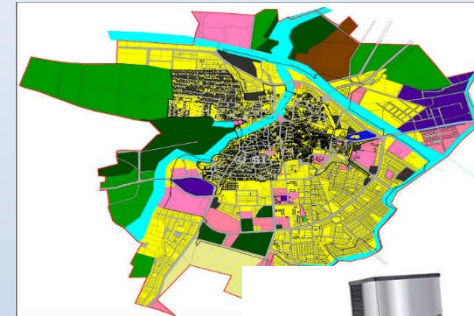
# Characterizing the CII Sector

- Highly diverse – more heterogeneous than residential
- Customers harder to classify – inconsistent classifications
- Water use is a “derived demand” that is bundled into production of goods and services
- Significant variability in water use between and within classes of customers
- “Explanatory” data generally lacking

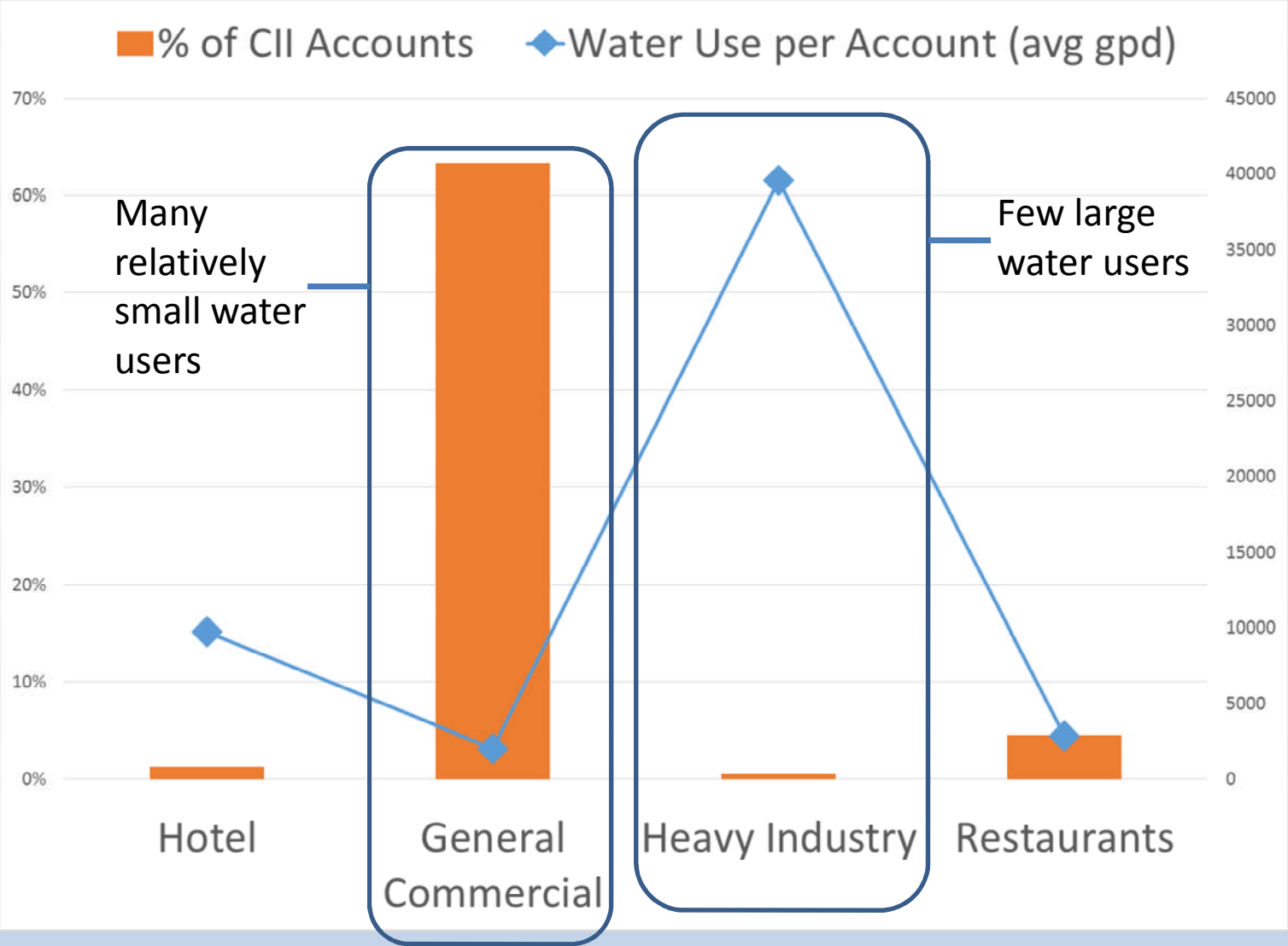


# Common CII Sector Research Needs

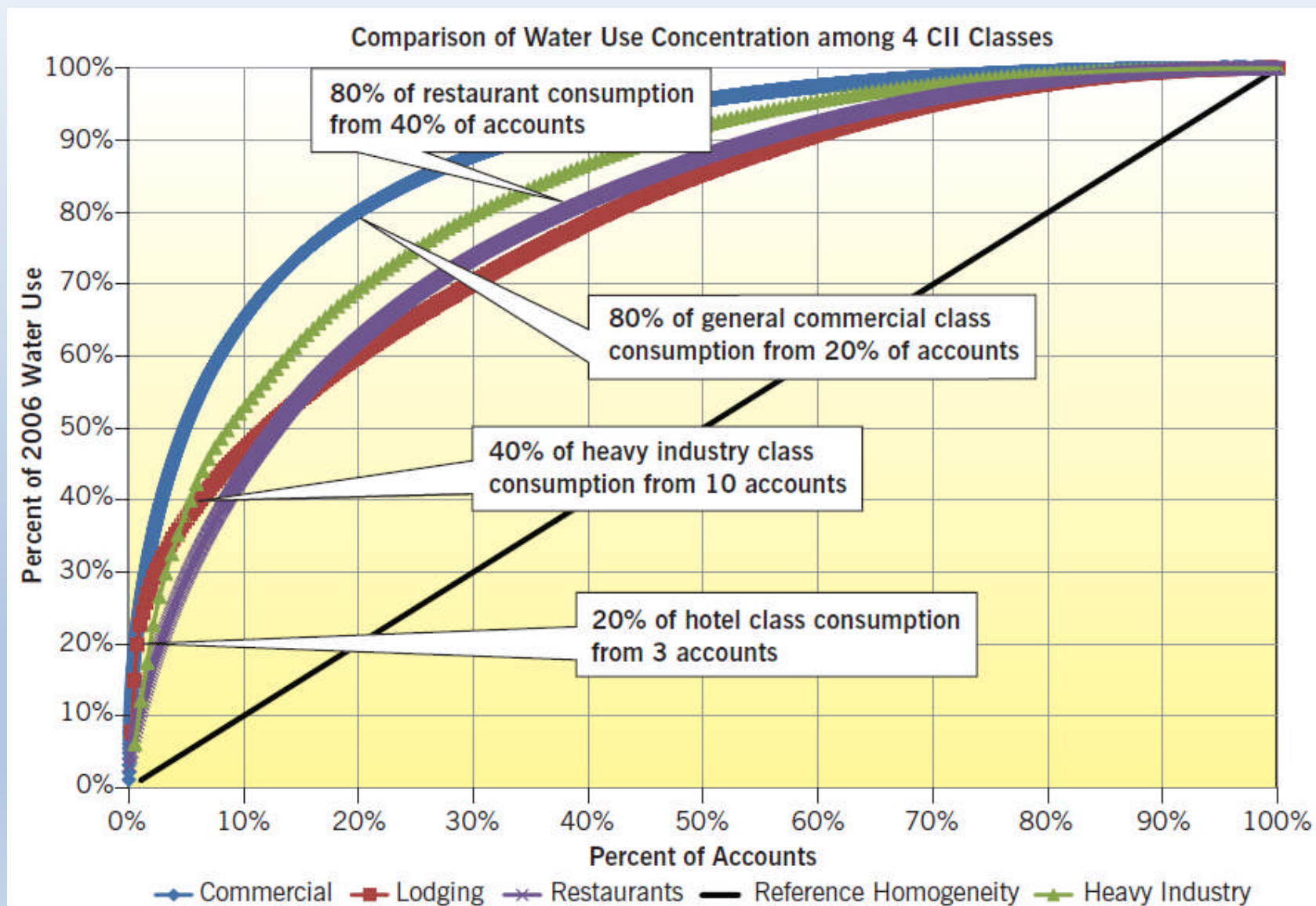
- Improve water use **forecasts**
- Anticipate impacts of **new business developments**
- Identify and target customers for water **efficiency programs**
- Develop usage rate **metrics** for **benchmarking**
- Design of **rate structures**



# Variability among Classes



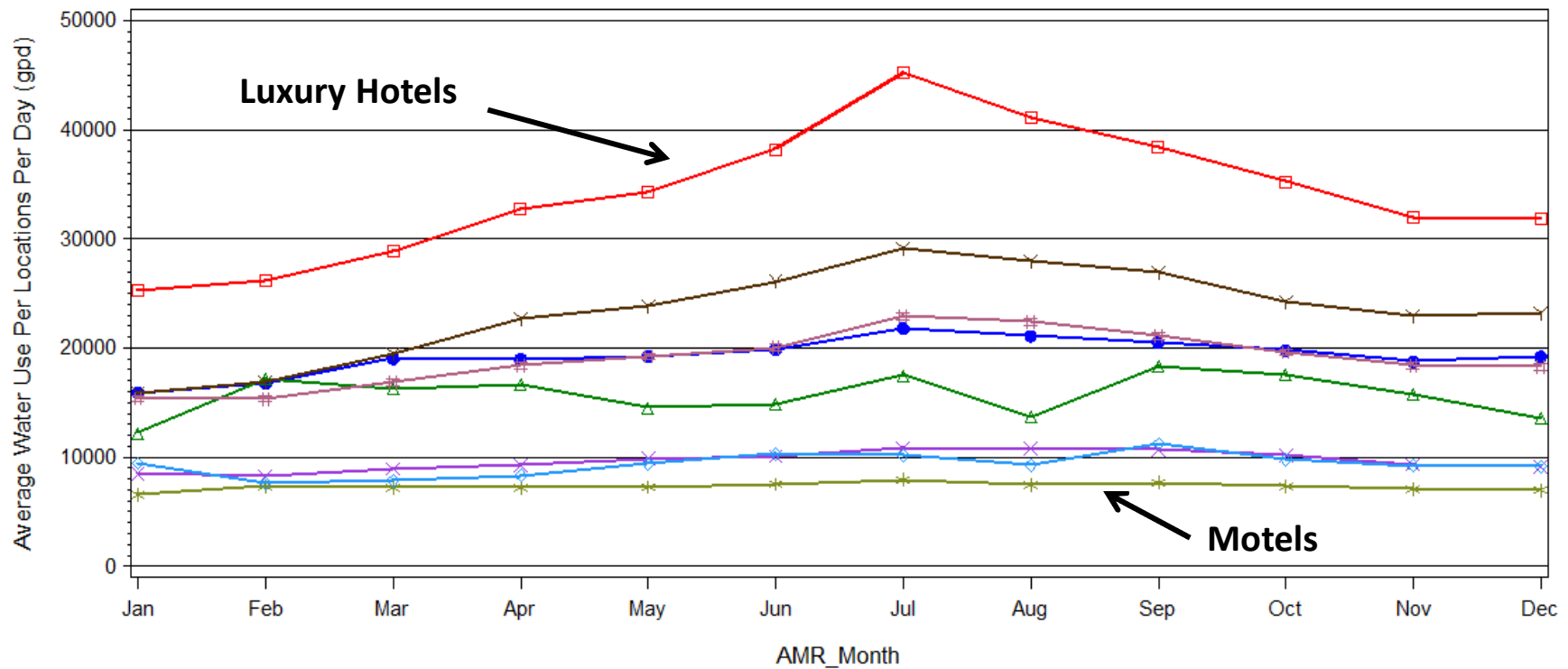
# Heterogeneity within Classes



# Within-Class Variability (Lodging example)

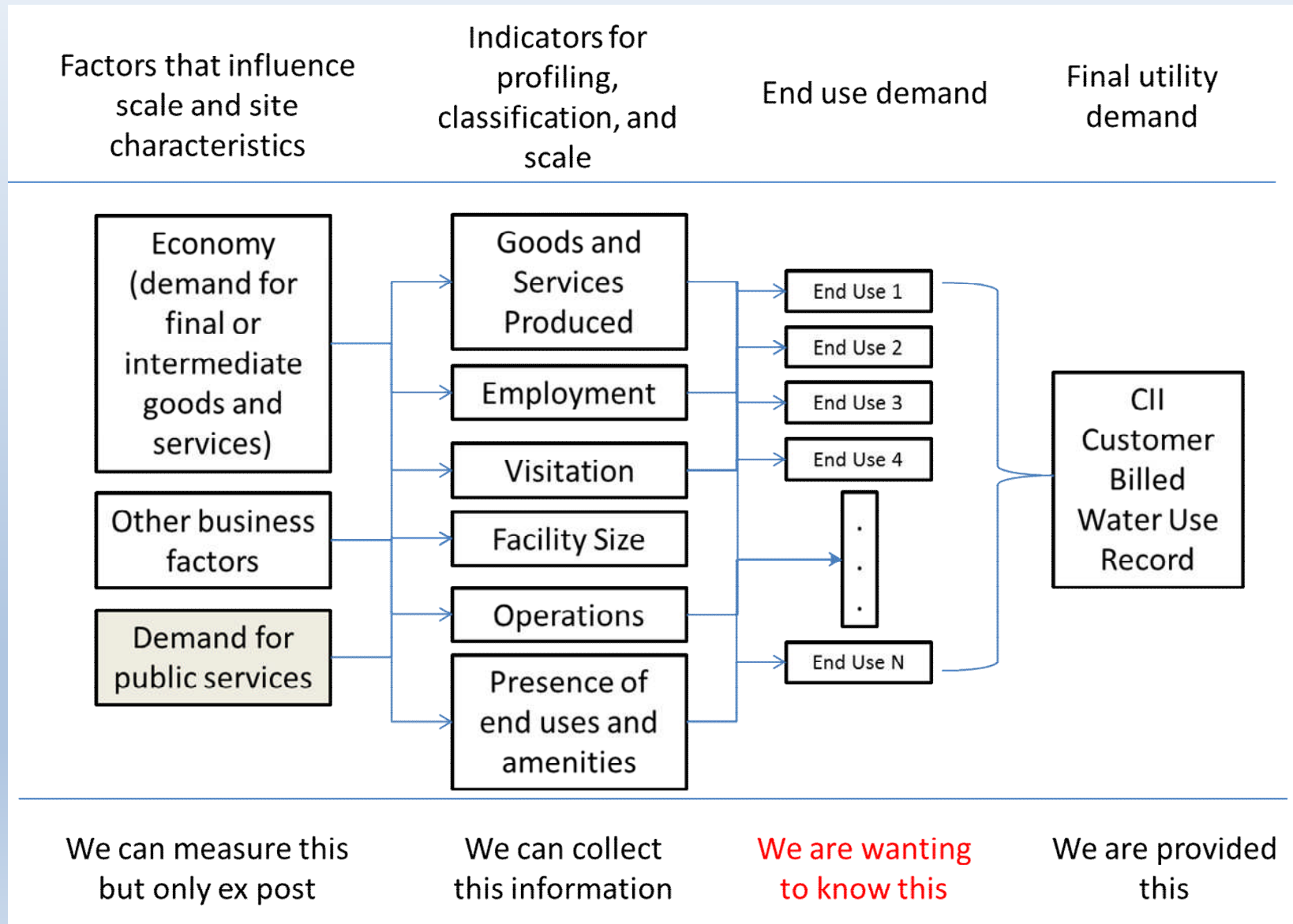
## Monthly Average Water Use Per Location Per Day

Major\_Class\_Description=HOTELS



- Apartment Hotels, (H6), n=14
- Luxury Type - Built After 1960, (H2), n=37
- ×—× Miscellaneous, (H9), n=147
- ◇—◇ Private Club, Luxury Type, (H5), n=16
- △—△ Dormitories, (H8), n=24
- ×—× Luxury Type - Built Prior to 1960, (H1), n=15
- \*—\* Motels, (H4), n=37
- ◆—◆ Transient Occupancy-Midtown Manhattan Area, (H3), n=38

# Basics of the “CII Problem”





# CII Research Challenges

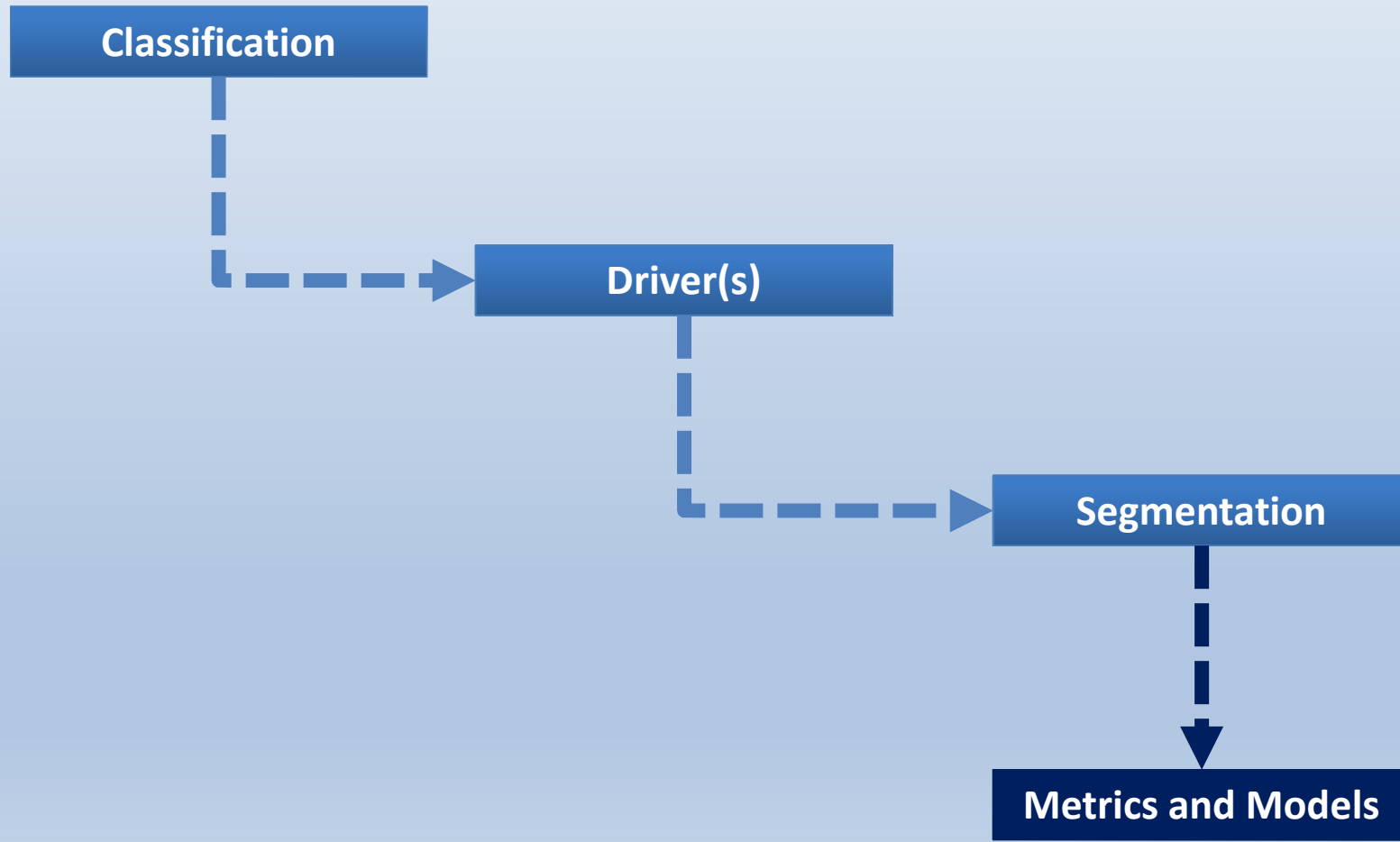
## Cross-Sectional

- Differences in efficiency easily hidden within variability
  - Scale, production activity
  - Presence of irrigation
  - Operating conditions
  - Type of goods/services
- Hard to establish “apples to apples” comparisons
- Multiple meters
- Definition of “customer”
- Accuracy of secondary data

## Time-Series

- Demands for goods and services fluctuate
  - Seasonal
  - Business cycle
  - Competitive environment
- Climatic sensitivity of some CII end uses and products
- Availability and accuracy of economic forecasts
- Individual agents versus sectors

# 3 Key Areas of Methodological Emphasis



# Basics of Emerging CII Methodology

- Need to classify customers along some common definitions and “functional” criteria
- Vast majority of CII water use and accounts reside in 20-25 categories
- End use dominant classes relatively easy to define



# CII Classification Scheme – 15 Principal Categories

1. Lodging
2. Office Building
3. School or College
4. Health Care Facility
5. Eating or Drinking Place
6. Retail Store
7. Warehouse
8. Auto/Auto Service
9. Religious Building
10. Retirement or Nursing Home
11. Manufacturing
12. *Other Commercial*
13. *Other Institutional*
14. *Largest Individual Users*
15. Dominant End Use
  - Landscape only
  - Laundromat
  - Commercial or Industrial Laundry
  - Car Wash
  - Park or Recreational Area
  - Golf Course
  - Power Plant/Utility
  - Server Facility/Data Center

# Example Drivers of End Use Consumption and Related Proxies

End Use Category	Demand Drivers	Proxies of Scale or Capacity		
Cooling (water based)	Preferences/Policies	Tonnage	Cubic Footage	Square Footage
Irrigation	Irrigated Landscape Area	Irrigable Area	ET	Air Temperature
Sanitary	People (Visitors + Employment)	Number of Fixtures	Square Footage	Number of Employees
Process water	Production Level	Number of Employees	Square Footage	
Food service	Volume of service (meals served)	Area	Number of Employees	Seating capacity

Single water use record not broken into end uses

Multiple end uses

Multiple drivers or proxies of scale

Some info only available or derivable from customer

# Differentiating Scale from Rate (or Intensity) of Use

$$Q \equiv \left( \frac{Q}{N} \right) \times N = q \times N$$

↑                      ↑  
Rate of use          Driver

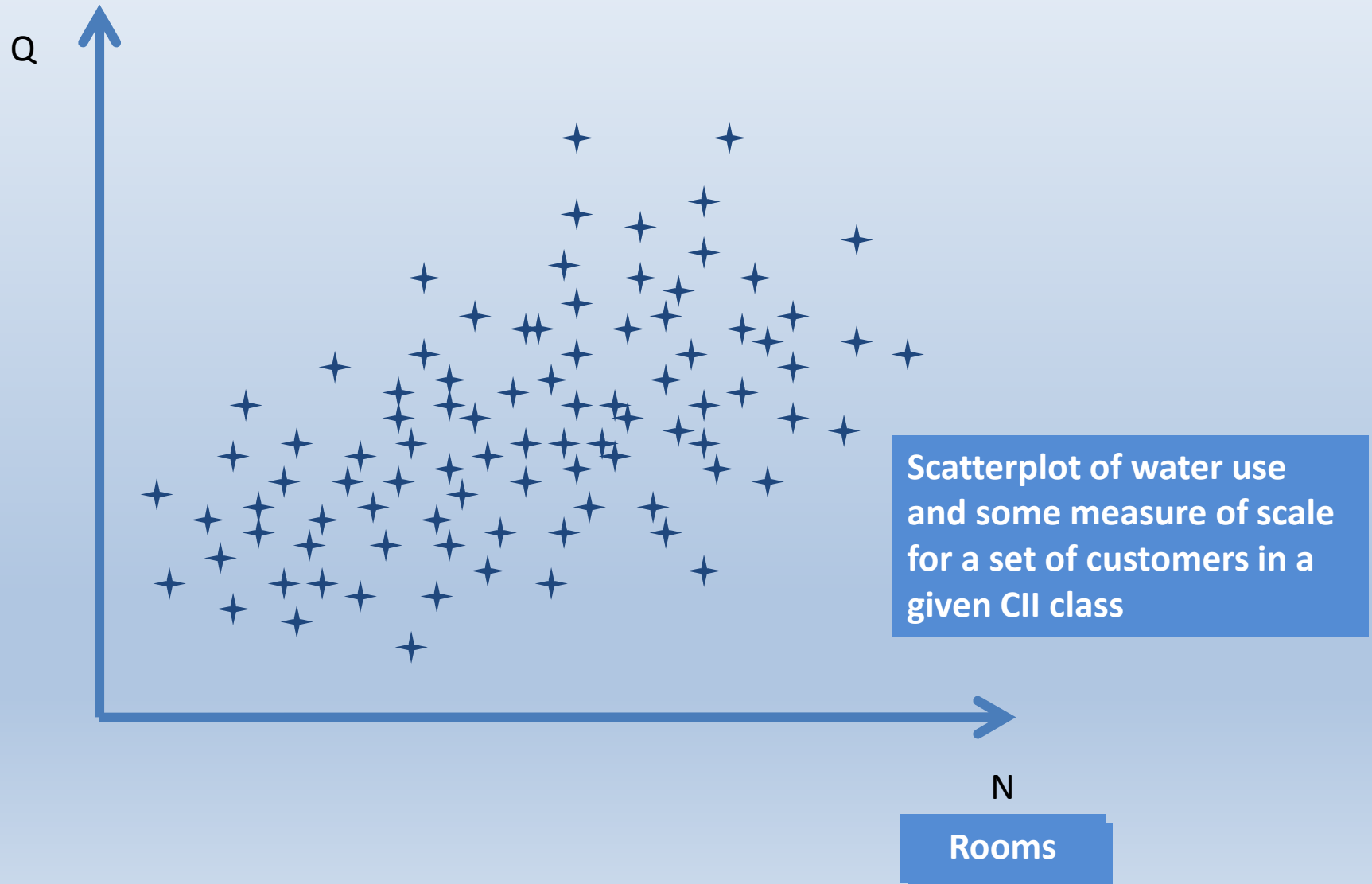
For example:

Water use in a school = avg. water use per student x students

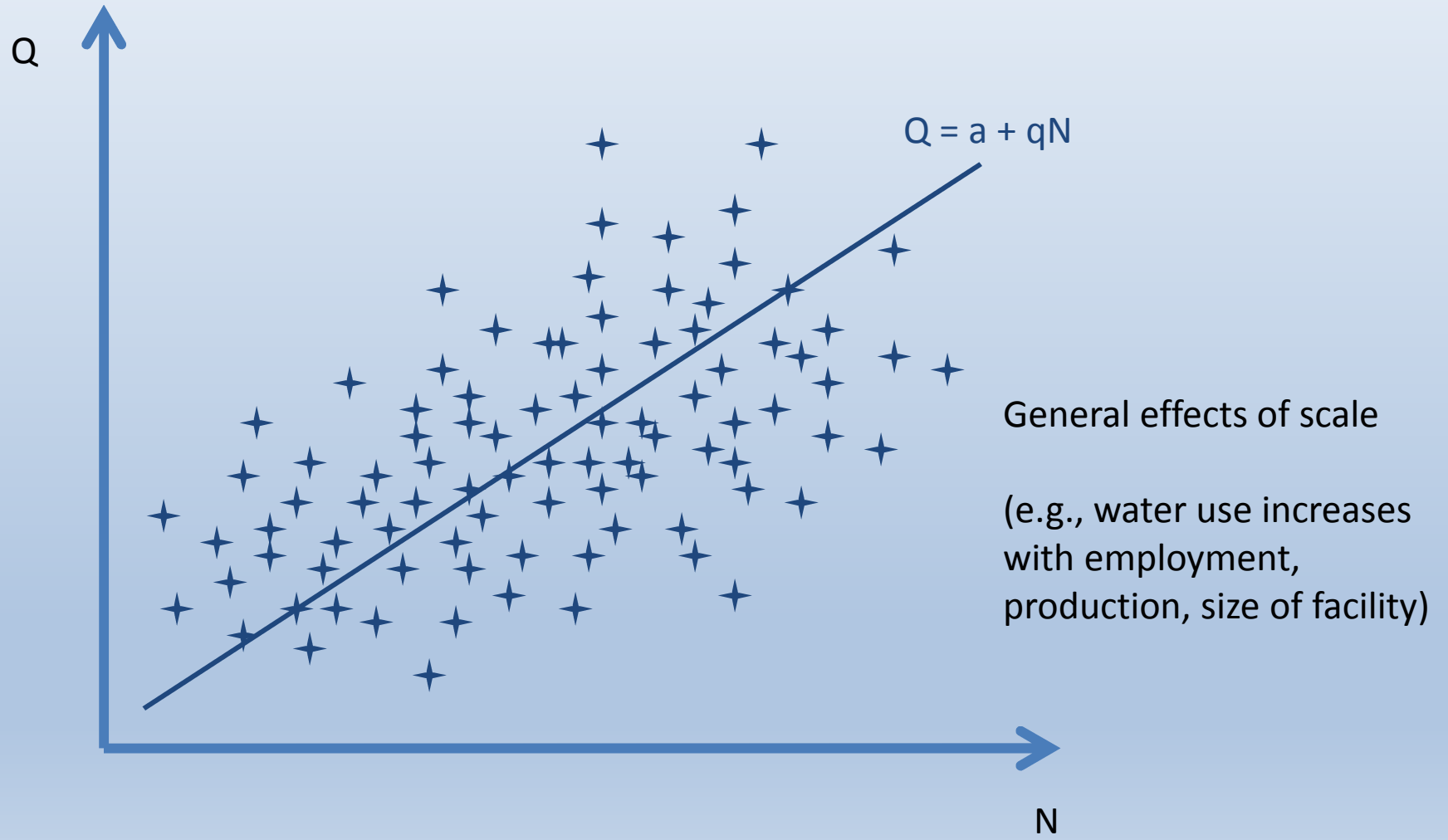
Water use in hotel = avg. water use per occupied room x occupied rooms

Water use for irrigation = avg. water use per irrigated sq. ft. x irrigated area

# Scale, Intensity, and Segmentation

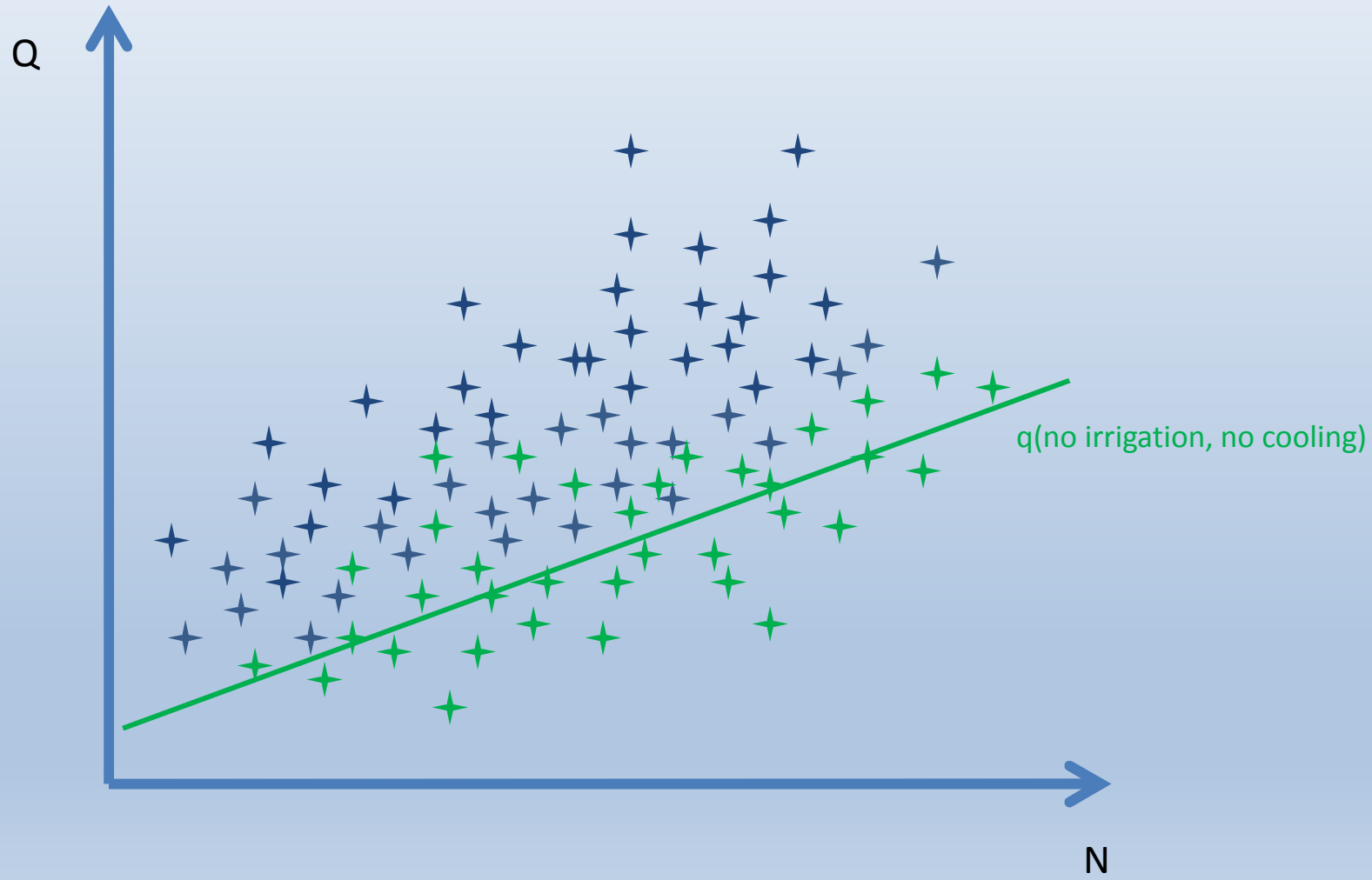


# Scale, Intensity, and Segmentation

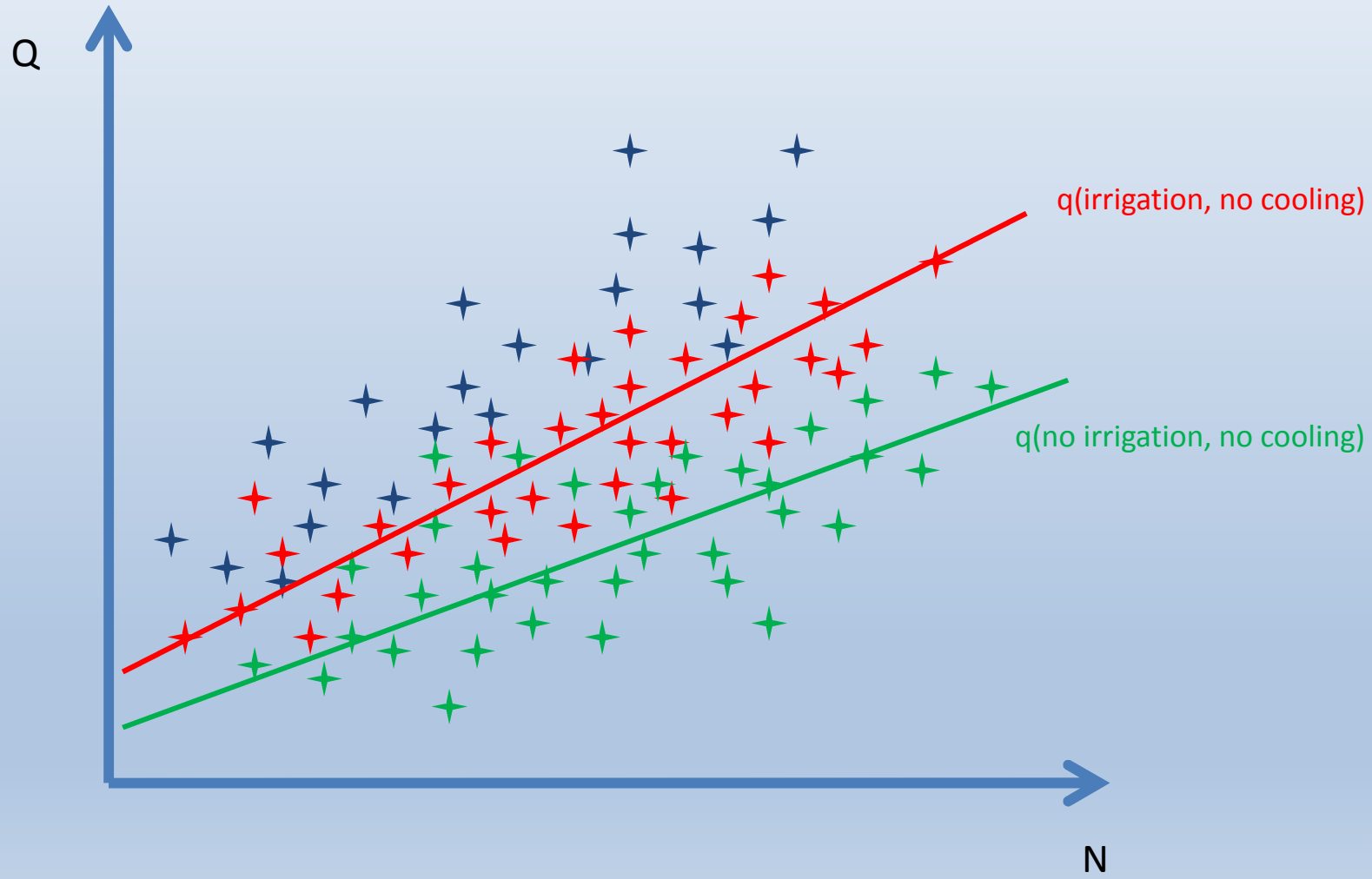




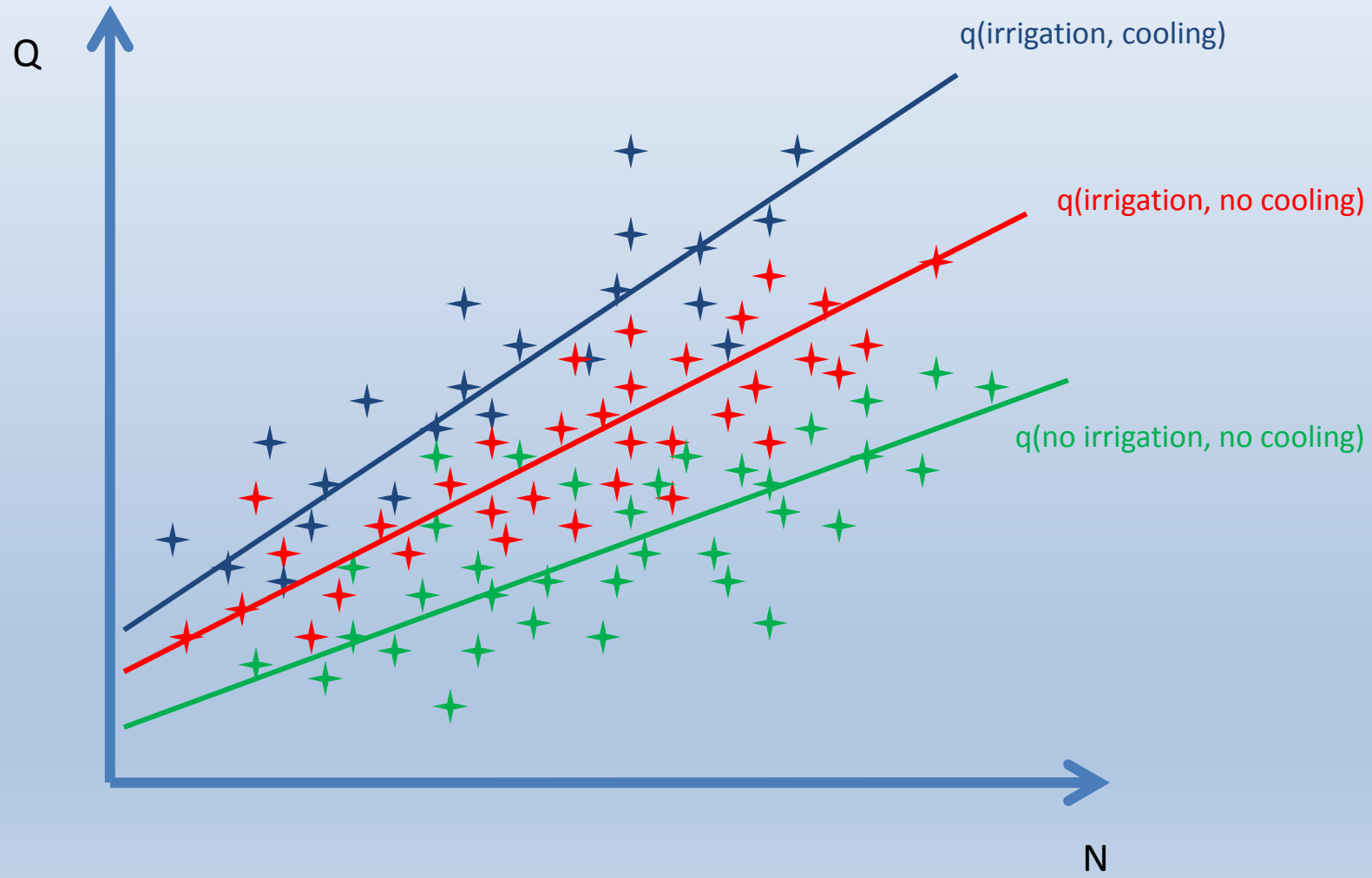
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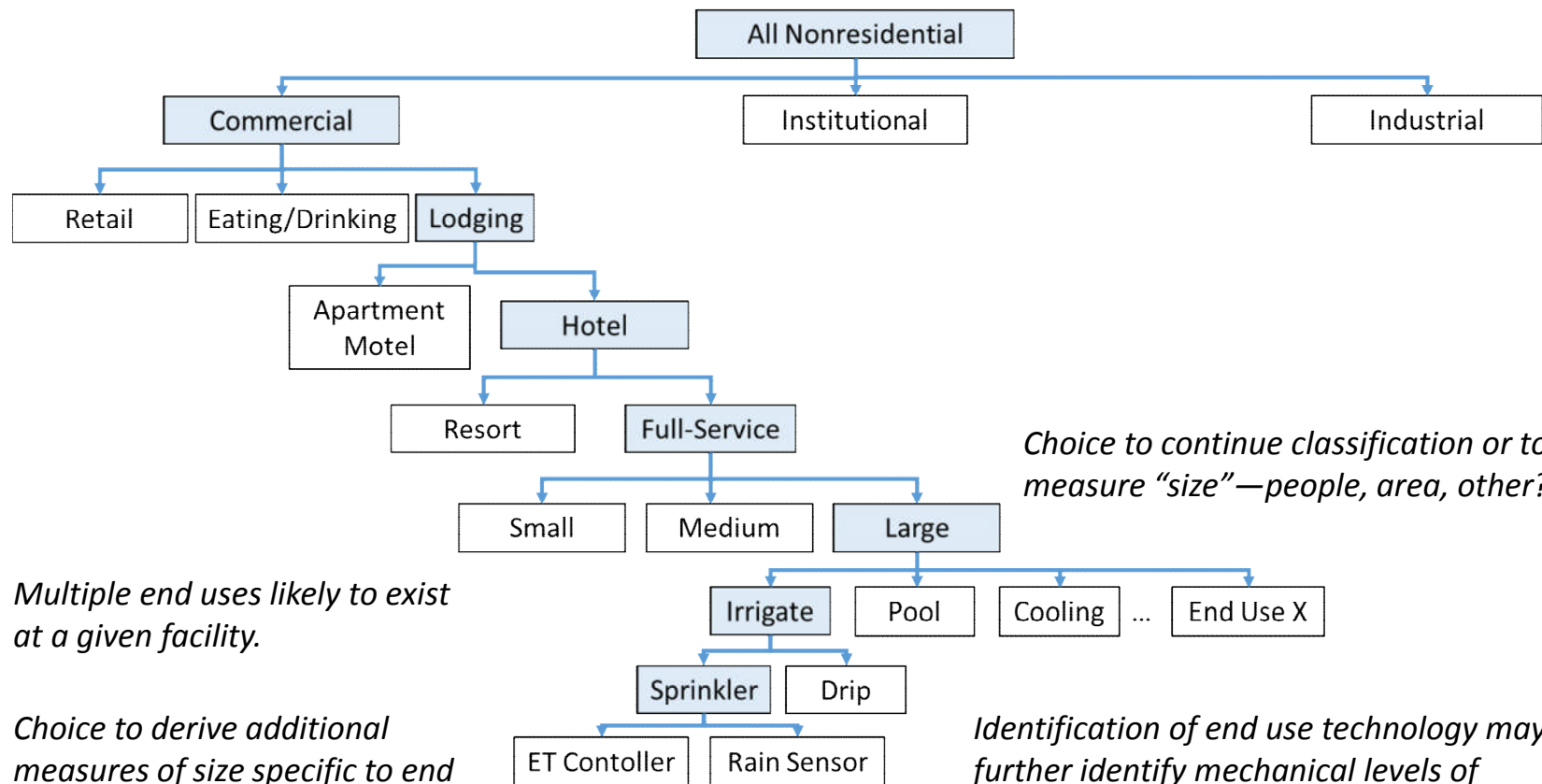
# Scale, Intensity, and Segmentation



# Scale, Intensity, and Segmentation



# Segmentation Tree Example



*Choice to continue classification or to measure "size"—people, area, other?*

*Multiple end uses likely to exist at a given facility.*

*Choice to derive additional measures of size specific to end use—acres, tonnage, volume?*

*Identification of end use technology may further identify mechanical levels of water efficiency.*

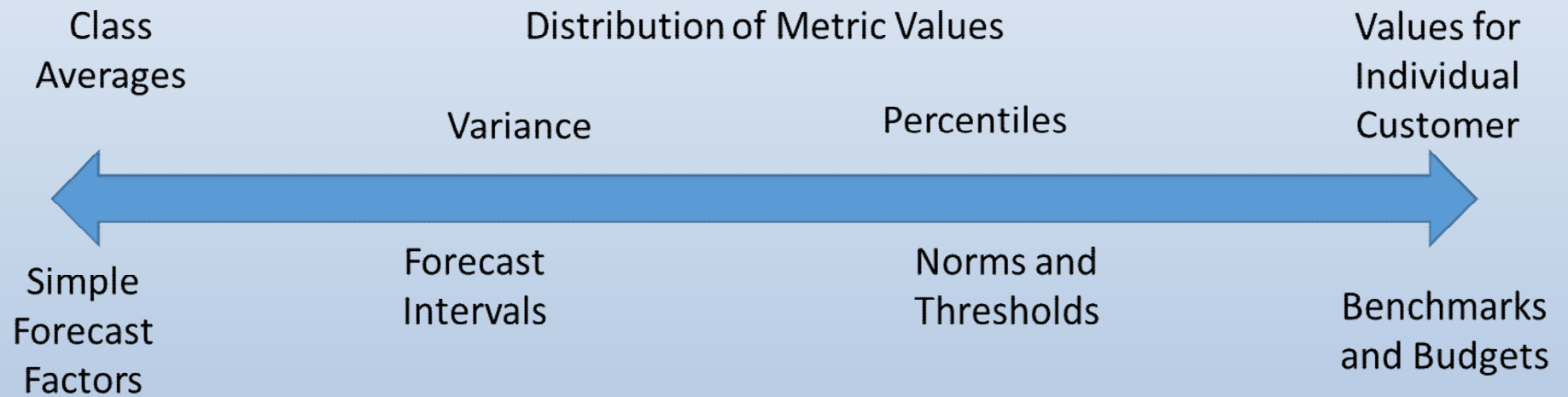
**Some level of segmentation and grouping will likely require site-level information.**

**At some point, use of statistical controls will likely be more efficient than adding more and more groups.**

# Basics of Emerging CII Methodology

- Matching to tax appraiser/parcel data
  - Assists in classification (property or building-type codes)
  - A useful measure of scale: square-footage
  - Common spatial identifier to link to other data sources
- Use of business data and other available secondary sources of information
  - Additional classification (NAICS)
  - Another useful measure of scale: employment
  - Class-specific information
- Surveys of customers (audit or pre-audit level)
  - Permits better definition and portrayal of activity and operations
  - More explanatory factors/covariates

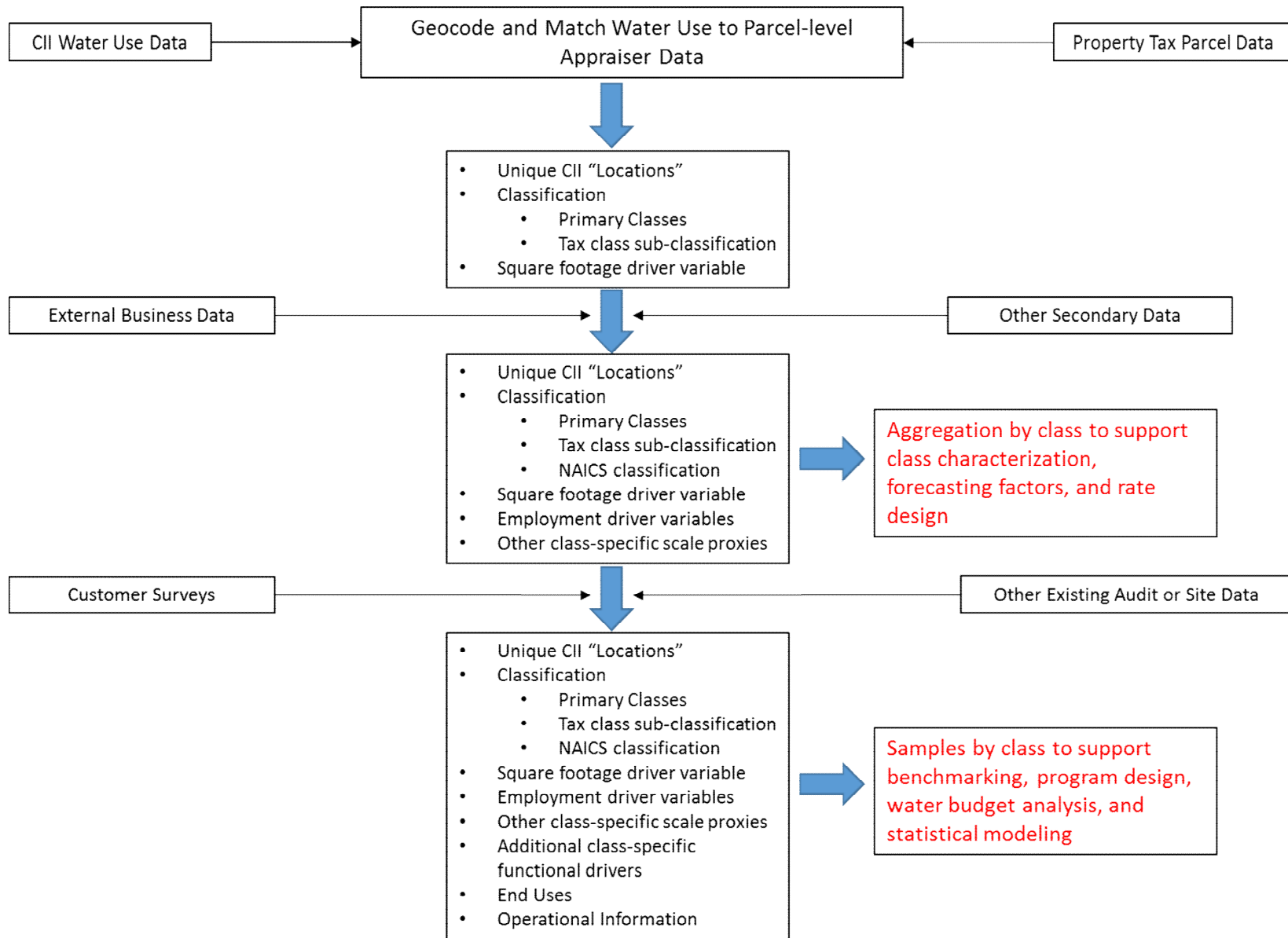
# Research Objectives and Use of Metrics



**What is sufficient for forecasting purposes will likely not be sufficient for benchmarking**

**What is needed for benchmarking purposes could support forecasting**

# Elements of Recommended Methodology



# Thanks!

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- City of Fort Collins
- Colorado Springs Utilities
- Tampa Bay Water
- City of Phoenix

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  - William (Bill) Hoffmann
- Maureen Hodgins, Water Research Foundation