ALLIANCE FOR WATER EFFICIENCY

WATER EFFICIENCY & CONSERVATION SYMPOSIUM 2025

AUGUST 6-8, 2025 | CHICAGO, IL

The Future of Demand Forecasting: Navigating Water Planning in a Changing World

Room 400 2:15 – 3:10pm

This Session is Brought to You By

Gold-Level Sponsor:

Evaluating Changes in Peak Demand and How That May Affect the Choice, Design, Management, and Evaluation of Demand Management Strategies

WRF 5265

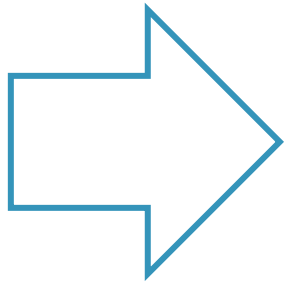
Devin Smith

Researcher, Alliance for Water Efficiency

Evaluating Changes in Peak Demand and How That May Affect the Choice, Design, Management, and Evaluation of Demand Management Strategies

Funded by the Water Research Foundation

- Definitions & use cases
- Historical Trends
- Current Drivers
- Future Influences
- Management Strategies
- Guidance
- Examples



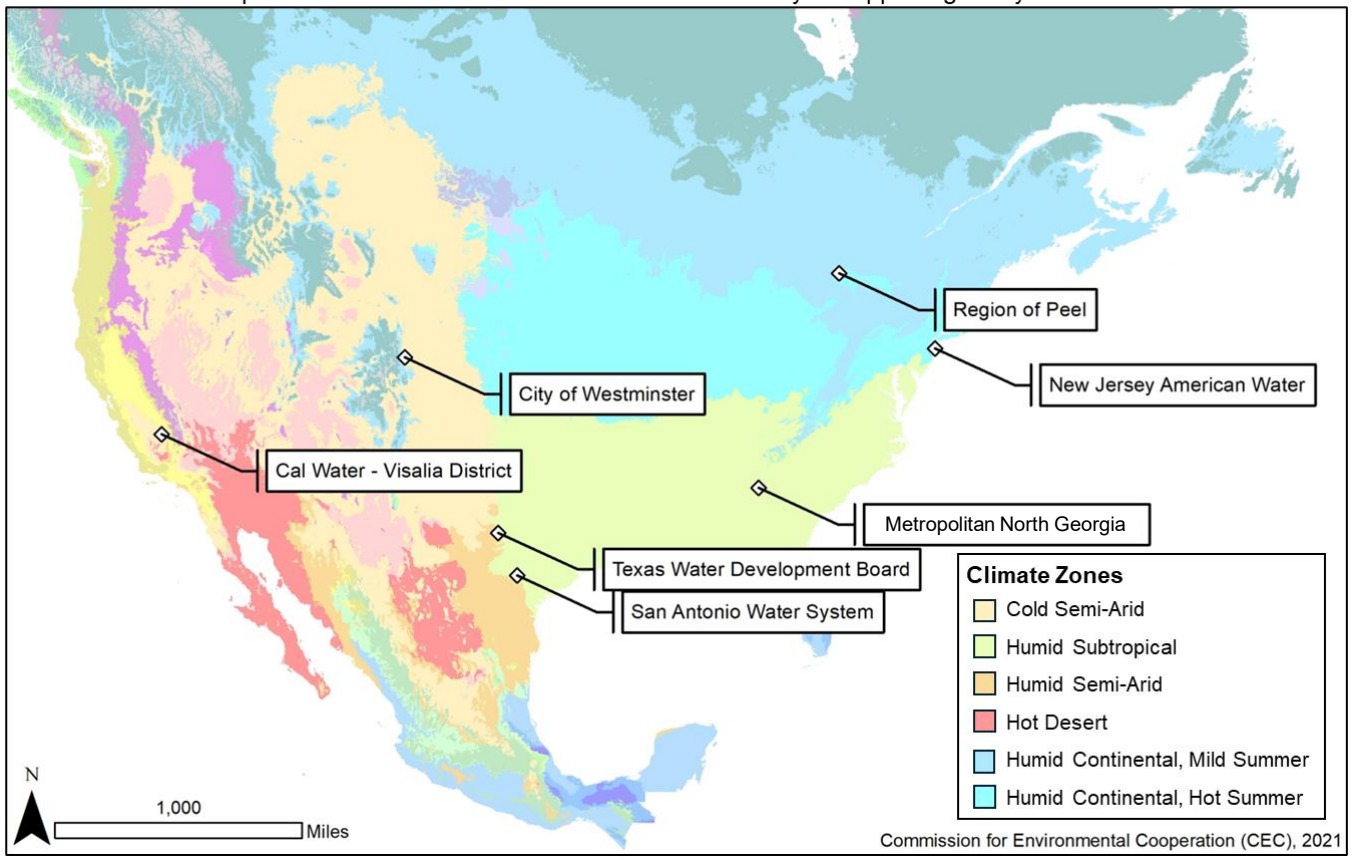
- ✓ 4 case studies
- ✓ 3 supporting studies
- ✓ Analysis of demand trends
- ✓ Synthesis and characterization of demand management strategies

WRF 5265

CASE STUDIES & SUPPORTING STUDIES

Utility/Organization	Data Range	Connections
San Antonio Water System	1994 - 2023	875,148
City of Westminster	1993 - 2023	34,131
Region of Peel	2010 - 2023	337,028
New Jersey American Water	1998 - 2023	136,549
Metropolitan North Georgia Water Planning District	2006 - 2023	-
Cal Water - Visalia District	2014 - 2023	45,550
Texas Water Development Board	2019 - 2023	-

Map of North America Climate Zones with Case Study & Supporting Study Locations



PEAK RATIO

Max Day/Average Day = Peak Ratio

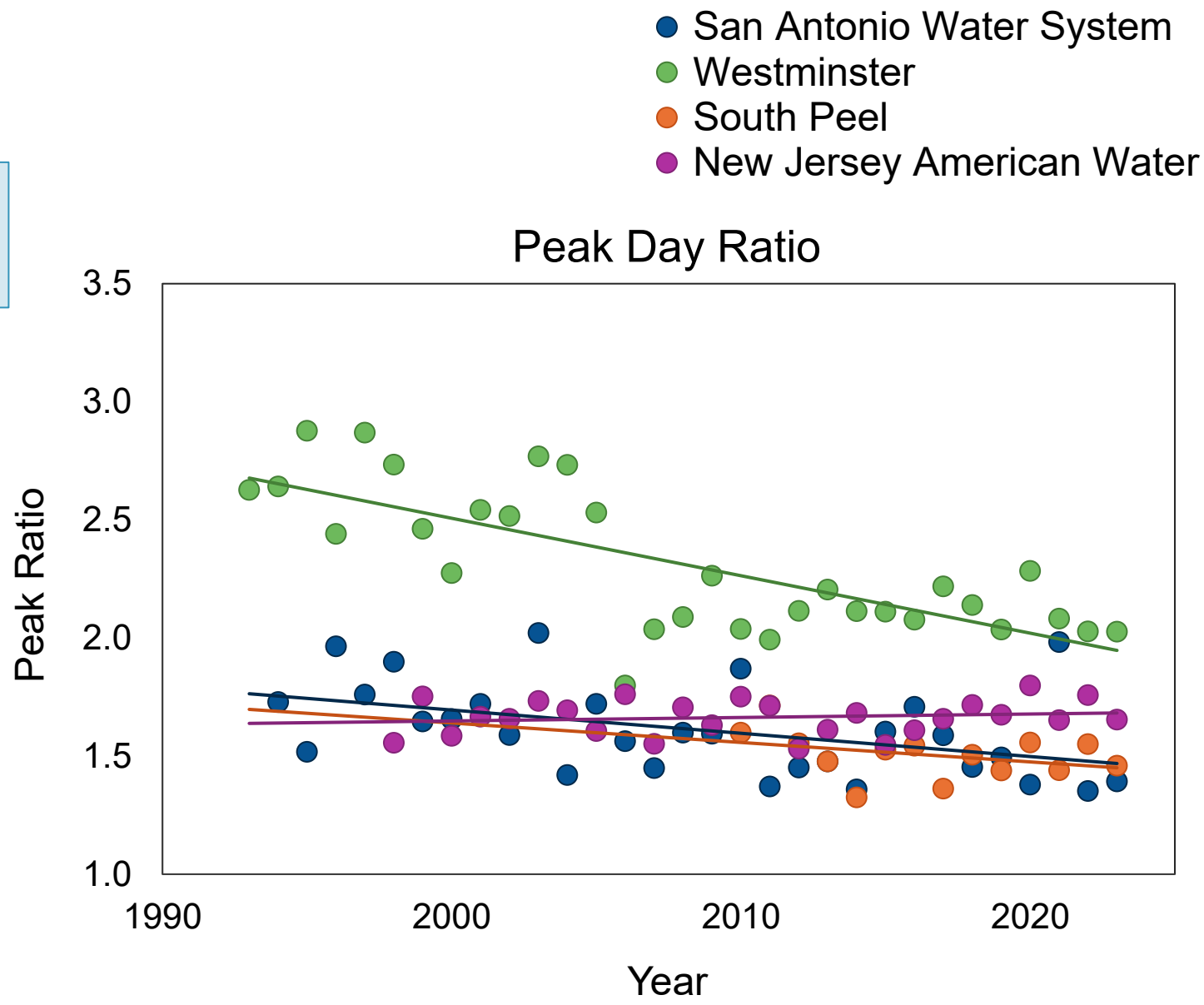
unitless

San Antonio Water System
decreasing at a rate of 0.009

City of Westminster
decreasing at a rate of 0.02

Region of Peel (South Peel)
decreasing at a rate of 0.008

New Jersey American Water
increasing at a rate of 0.001



PEAK RATIO

Max Day Ratio

unitless

San Anto
decreasi

City of W
decreasi

Region o
decreasi

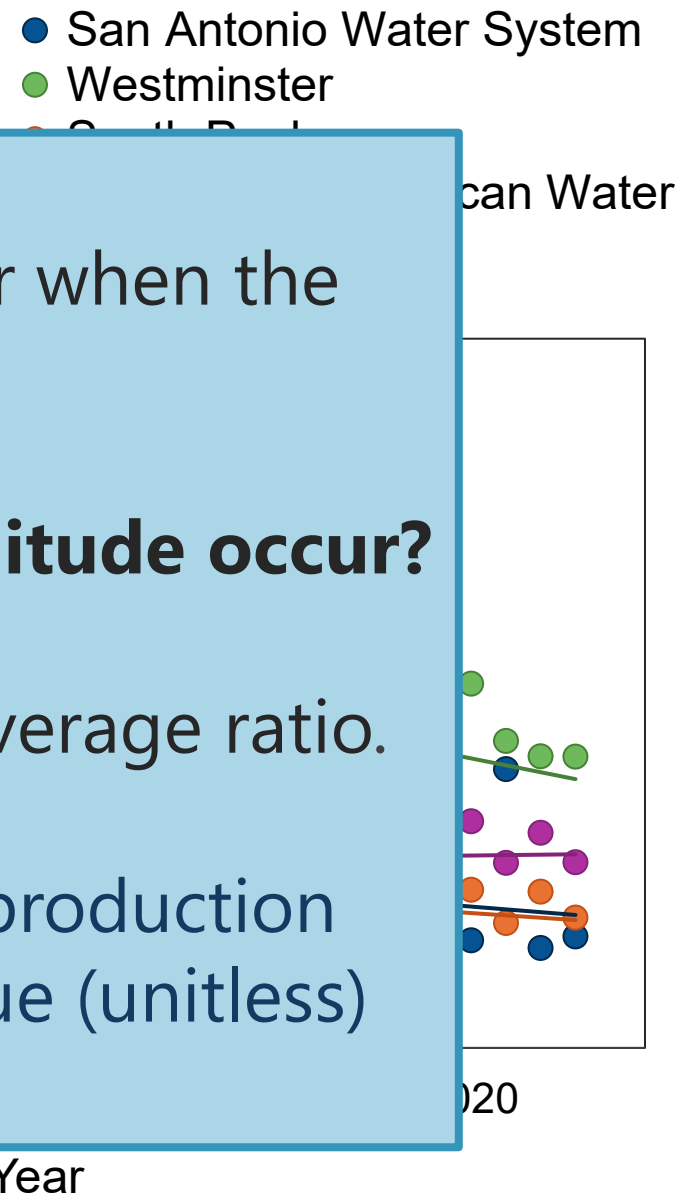
New Jers
increasin

Peak ratio represents a single day of a year when the max demand is met.

How frequently do demands of that magnitude occur?

Measure the daily production ratio to the average ratio.

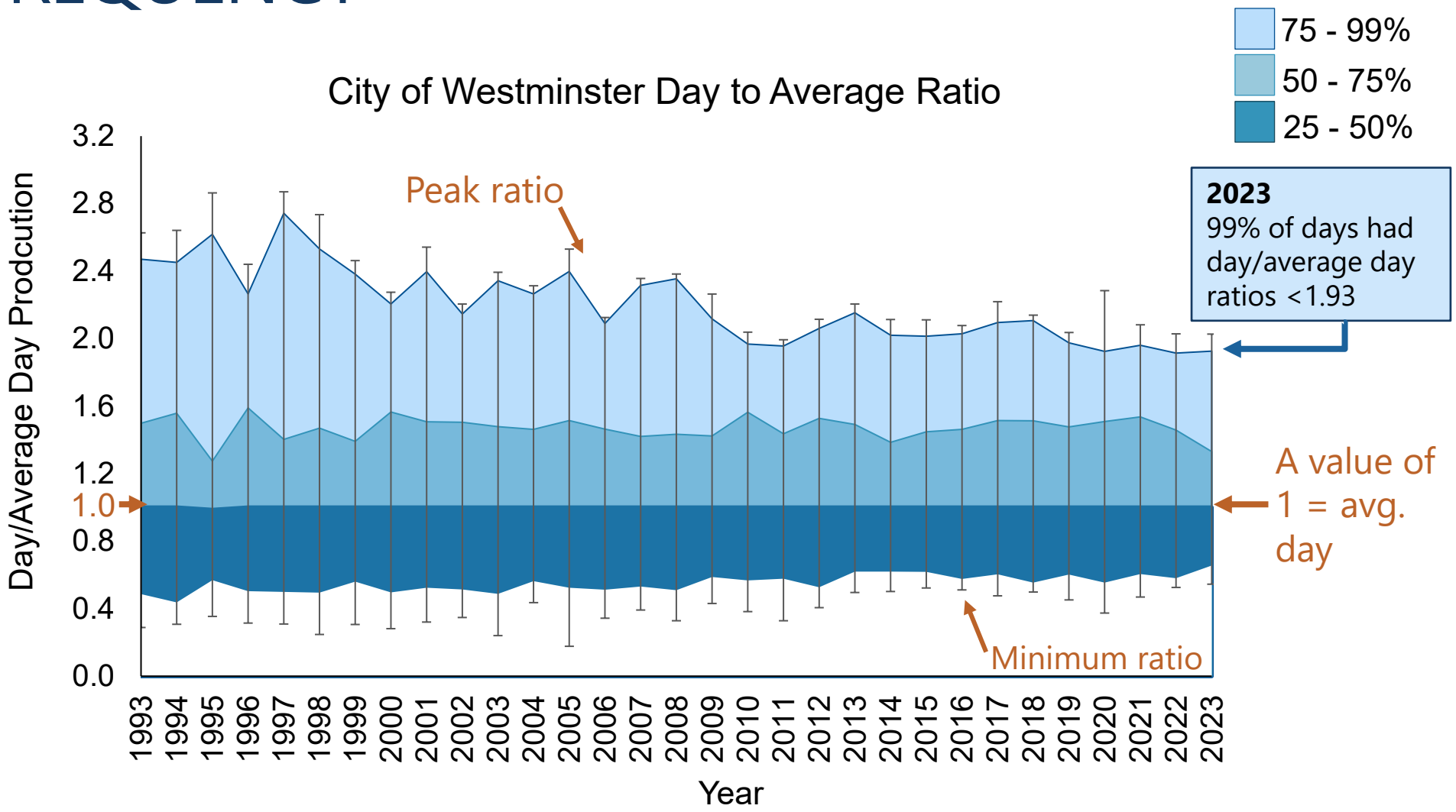
The Day to Average Ratio: A single day production divided by the average day production value (unitless)



PEAK RATIO FREQUENCY

The Day to Average Ratio: A single day production divided by the average day production value (unitless)

- **Graph shows how daily demand fluctuates around the average demand**
- Each gray bar represents the entire range of day to average ratios for each day in a year
- The shaded areas represent a percentage of days each year



WRF 5265

Evaluating Changes in Peak Demand and How That May Affect the Choice, Design, Management, and Evaluation of Demand Management Strategies

er Research Foundation

- Definitions & us
- Historical Trend
- Current Drivers
- Future Influence
- Management Strategies
- Guidance
- Examples

Coming Soon!

es

g studies

demand trends

nd characterization of demand management strategies

318 W Adams St., Ste. 1514
Chicago, IL 60606

OFFICE 773-360-5100

https://www.allianceforwaterefficiency.org

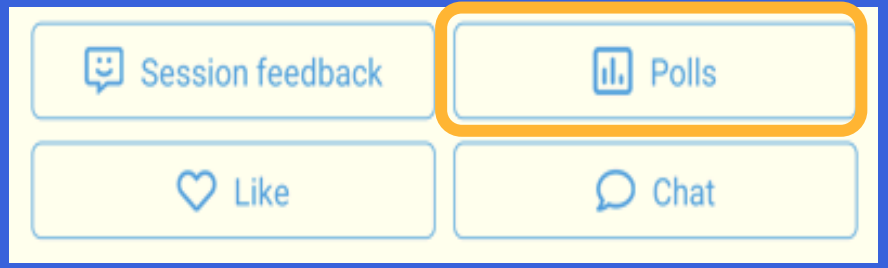
Alliance *for* Water Efficiency

Thank You!

Live Polling

Open your Whova apps to participate in a few session polls!

Navigate to the Whova app → Go to this session → Click on “Polls” → Select and respond to the question you see displayed on the screen



Poll Questions

- How familiar are you with water demand forecasting?
- What about demand forecasting interests you?
- How confident are you in the demand forecast that you currently use?

Why Accurate Water Demand Forecasts Matter

Colwyn Sunderland

Infrastructure Planning Engineer, Kerr Wood Leidal, CAN

Why Accurate Water Demand Forecasts Matter

KERR WOOD LEIDAL
consulting engineers

Colwyn Sunderland, Infrastructure Planning Engineer
csunderland@kwl.ca | 250.661.8958

Alliance for Water Efficiency Symposium
August 8, 2025

Overview

What is a water demand forecast?

- Understanding and quantifying likely future changes
- Utility and community planning context

Why does accurate forecasting matter?

- Different uses, different needs
- Forecast timeframe and uncertainty

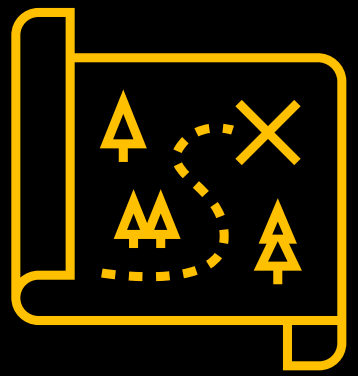
Imagine driving through an unfamiliar country at night…

How would you fare without headlights?

With low beams?

With high beams?

With high beams *and a good road map?*

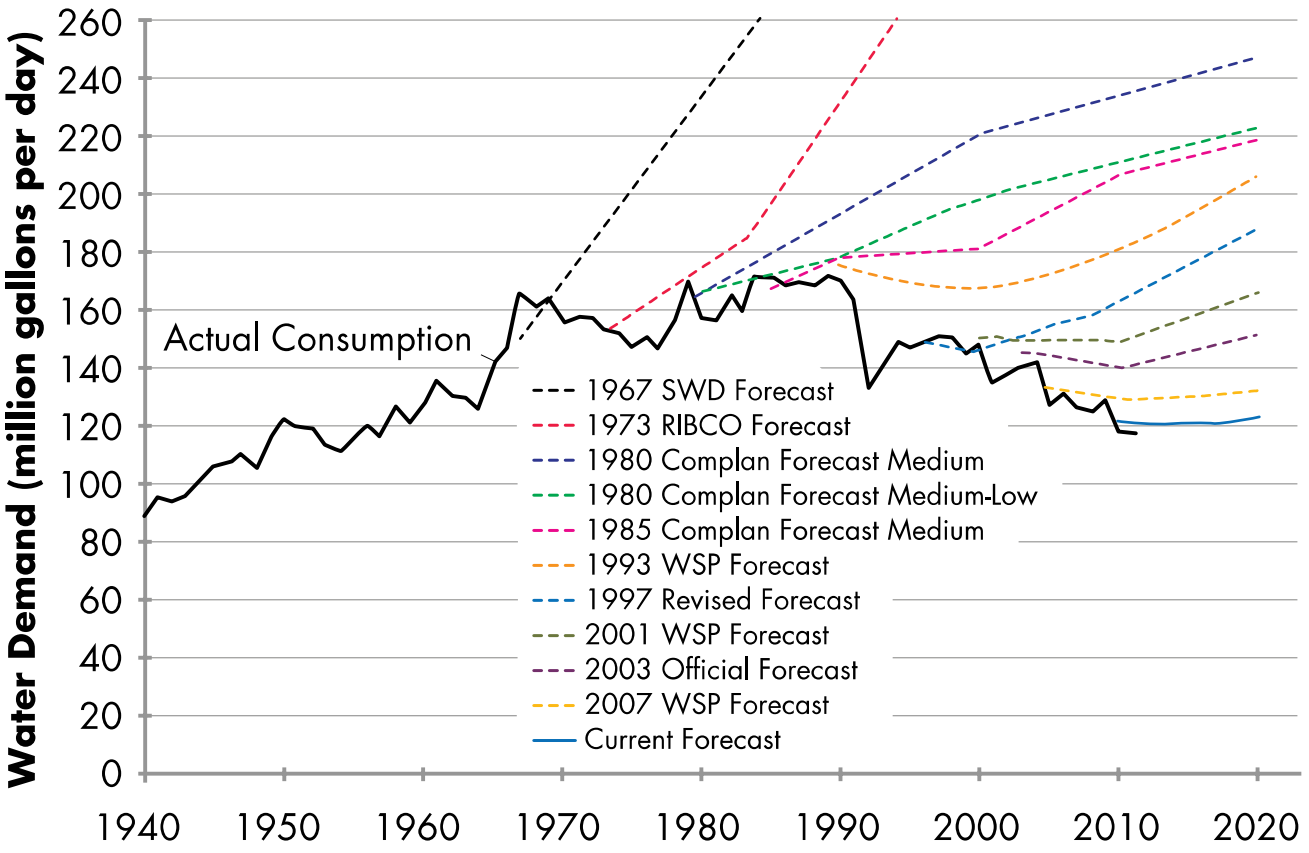


Why do we have "porcupine charts"?

We often incorrectly assume that:

- Historical water demand trends will continue
- Water use will change in proportion to population

We know these assumptions are unreliable, so we "err on the high side"…because *running out of water is bad!*



Historical water demand forecasts for Seattle[1]

1. Pacific Institute, 2016. *A Community Guide for Evaluating Future Urban Water Demand*

Why is accurate forecasting important?

Forecasts support a wide range of planning decisions, and with different implications of getting it wrong:

- **Engineering**
  - Too low – projects needed to service growing demands aren't built in time, or new assets are undersized
  - Too high – growth-driven projects are built too soon (wasting money) or too large (causing water quality and other operational problems)
- **Finance**
  - Too low – Funding is not in place when growth-driven projects are needed
  - Too high – Rate revenues are overestimated
- **Water Efficiency**
  - relies on a *very accurate* baseline forecast (not biased high or low) to effectively plan and measure program performance

A Forecast Shouldn't be a Single Line

Forecasting Best Practices[1]

1. Account for Water Conservation and Efficiency
2. Account for Climate Change and Drought
3. Account for Changes in Economic Activity
4. Account for Changes in Water Price
5. Consistency with Other Planning Documents
6. Account for Expected Land Use Changes
7. Account for Uncertainty
8. Ensure Transparency and Review

Manage uncertainty by:

- Breaking down *base and seasonal* demands
- *Scenario analysis* for climate change, population, economics, and policy changes
- *Land use assessment* for sectors and end uses
- Incorporating *non-revenue water*
- *Calibration and uncertainty assessment* using probabilistic methods
- *Engagement and training*

1. Pacific Institute (2016). *A Community Guide for Evaluating Future Urban Water Demand*

A Good Road Map Needs *Enough* Detail

- *Base and Seasonal* demands (or indoor and outdoor) have different drivers, and different implications for planning and demand management.
- *Scenario analysis* is necessary to practically understand uncertainty and to build resiliency through adaptive planning.
- *Land use assessment* unlocks the key impacts of changes in density, building form urban design on water demands.
- *Non-revenue water* completes the supply and demand balance, clarifying the business case for both water efficiency and distribution loss management initiatives.
- *Calibration and uncertainty assessment* enables one forecast model to serve a range of needs, and ensures uncertainties and safety margins are transparent.
- *Engagement and training* improves a forecast through feedback and refinement, and ensures the forecast is understood and used as intended.

Forecasting approach depends on timeframe

Operational and tactical decisions usually rely on **short-term forecasts** (a few weeks to a few years). These can often be based on simpler, largely probabilistic models based on a few input variables.

Longer-term forecasts (a few years to several decades) are needed for master planning, strategic planning and long-term financial planning. These usually involve sector, end use and land use modelling as well as uncertainty and scenario analysis.

The timing of demands is also an important decision. Peak demands are influenced much more by certain factors (often irrigation) than annual total or average demands, and therefore have different uncertainties.

Exploring Impacts of Climate Change and Other Drivers

Jessica Fritsche

Senior Planner, Carollo Engineers, IL

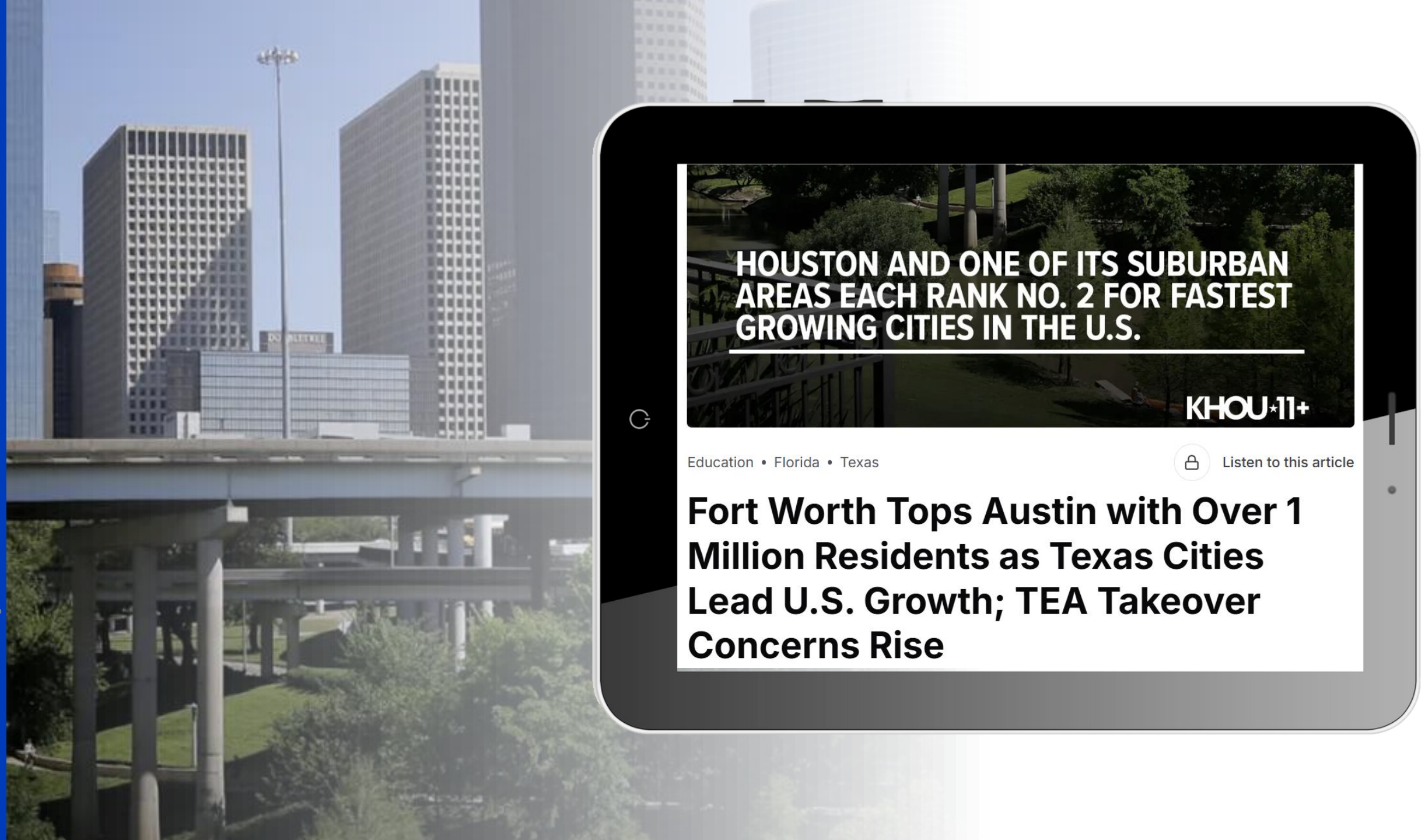
The Future of Demand Forecasting:

Navigating Water Planning in a Changing World

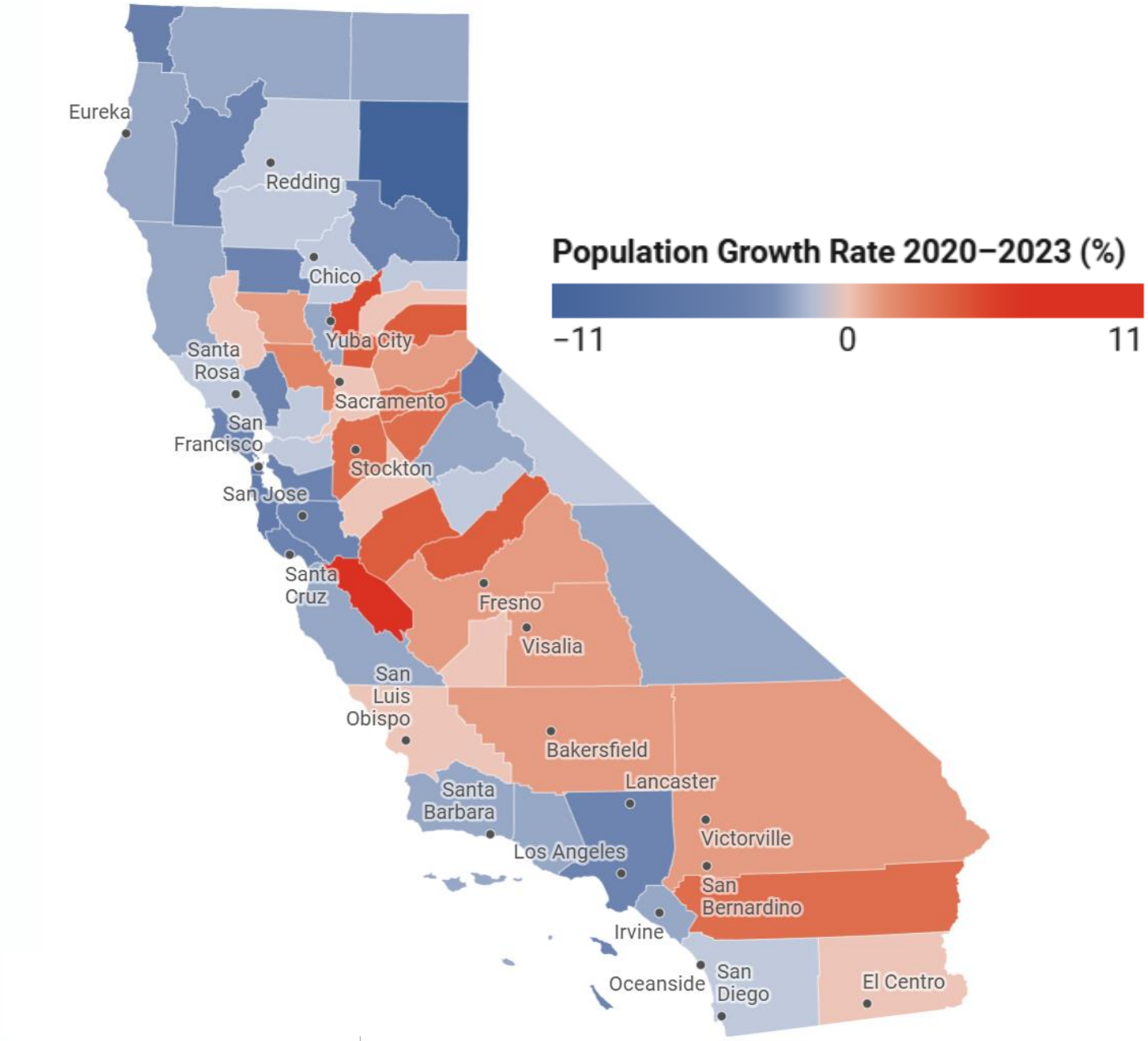
Jessica Fritsche, *Associate*
Carollo Engineers

2025 Water Efficiency and Conservation Symposium

carollo®


HOUSTON AND ONE OF ITS SUBURBAN AREAS EACH RANK NO. 2 FOR FASTEST GROWING CITIES IN THE U.S.
KHOU 11+
Education • Florida • Texas
Listen to this article
Fort Worth Tops Austin with Over 1 Million Residents as Texas Cities Lead U.S. Growth; TEA Takeover Concerns Rise

Map Reveals Where California **Numbers are Plummeting**



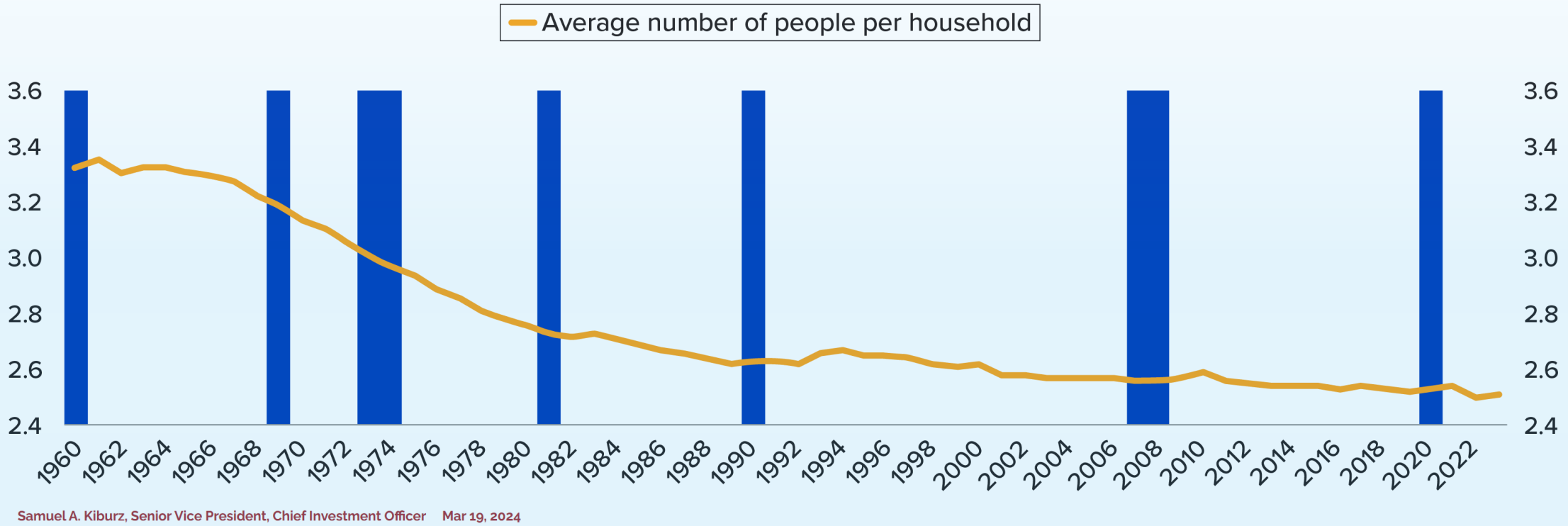
Published Oct 20, 2024 at 5:00 AM EDT | **Updated** Oct 21, 2024 at 7:47 AM EDT

A map shows the estimated population growth rate by county in California from July 2020 to July 2023, based on U. S. Census Bureau data. Click on individual counties for detailed information.

Chart of the Day:

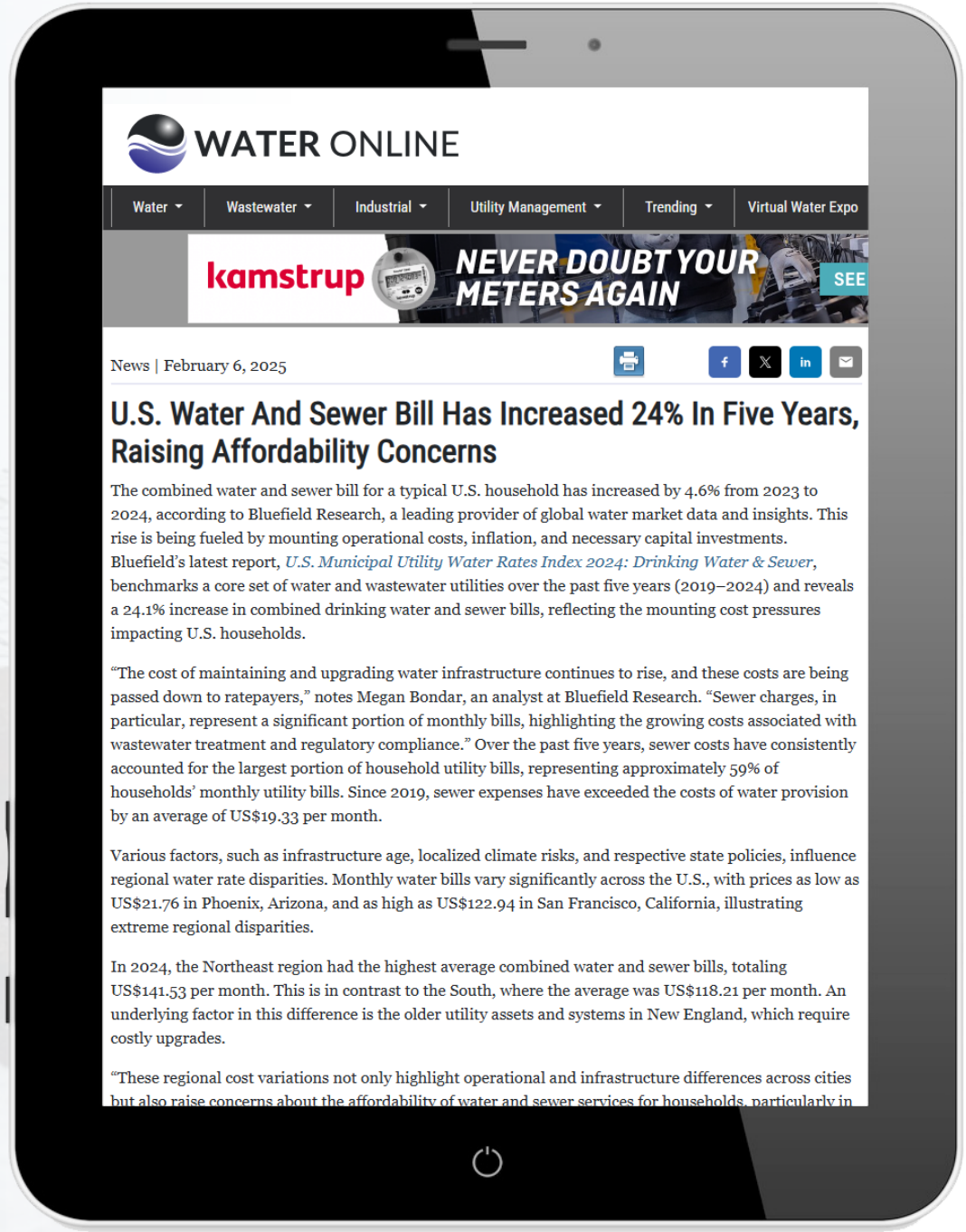
Family Size is Shrinking

- The average family size in the US has declined from 3.3 in 1960 to 2.5 in 2023



Water Online:

U.S. Water and Sewer Bill Has Increased 24% in Five Years Raising Affordability Concerns



Tiny Homes on Small Lots Popping Up in San Antonio Area

JOURNAL OF Housing & Community Development

Archive | About the Journal of Hou

Rethinking Zoning to Increase Affordable Housing

December 22, 2023
by Allison Hanley

by **Shari Biediger**
May 16, 2023

ARIZONA ENACTS NEW WATER CONSERVATION STANDARDS

Marcel Kuhn | June 18, 2025

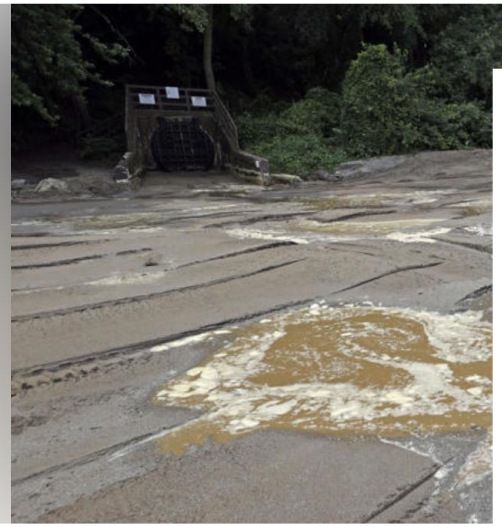
NEWS

Marcel Kuhn | June 18, 2025

Climate Change

The costs of climate change in Ohio: Cooling, flooding, asthma and more

Story by Peter Krouse, cleveland.com • 1w • 4 min read



Signs at Cleveland Metroparks Edgewater Beach warn beachgoers of a stormwate
© Joshua Gunter/cleveland.com/TNS

SIGN UP

EARTH·ORG

Climate Change | Energy | Pollution | Policy & Economics | Oceans | Biodiversity | Conservation | Solutions | Guides

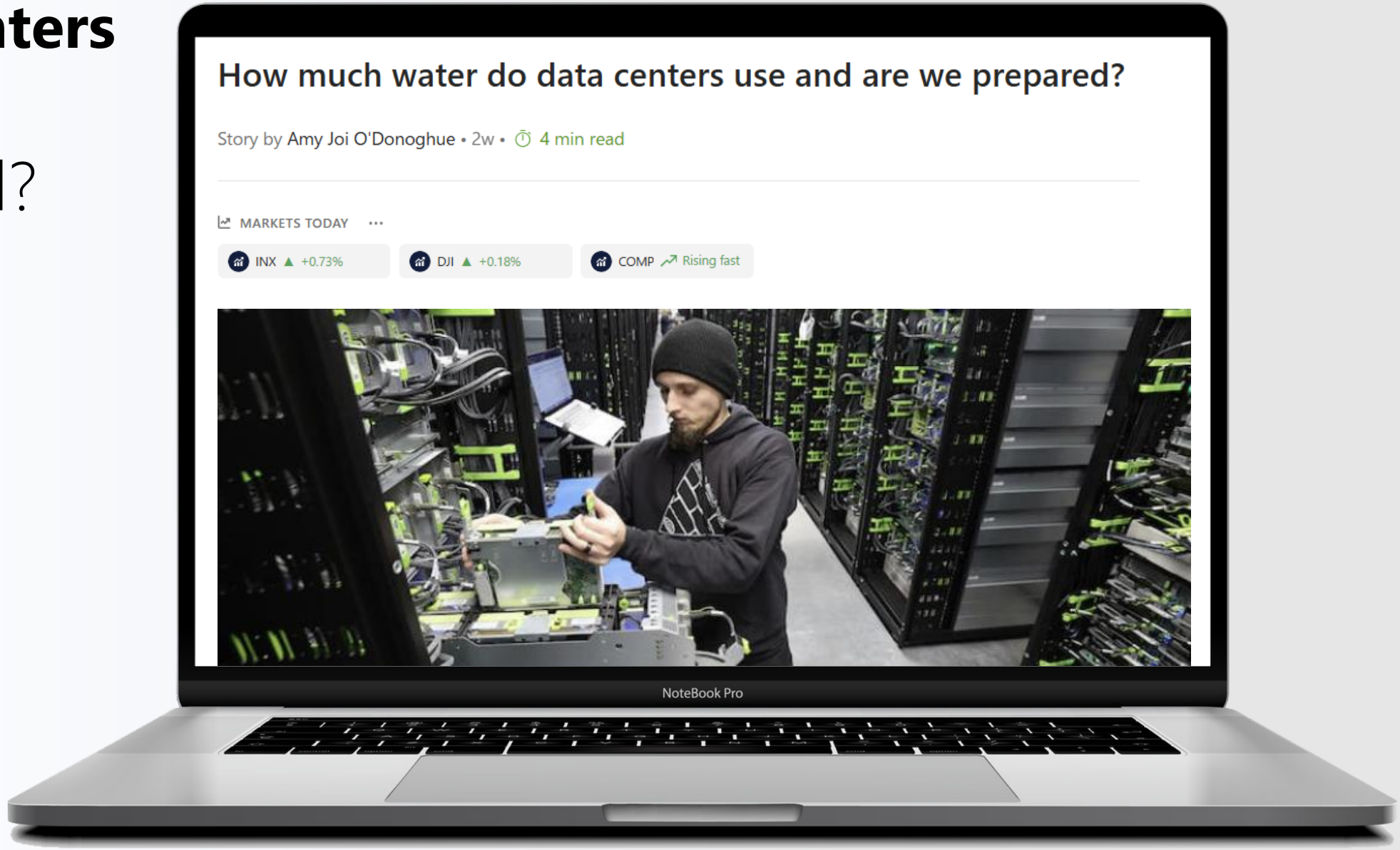
CLIMATE CHANGE | CRISIS - ATMOSPHERIC CO2 LEVELS

2024 'Virtually Certain' to Be Hottest in History, Marking 'New Milestone' in Temperature Records

BY MARTINA IGINI | GLOBAL COMMONS | NOV 8TH 2024 | 4 MINS

EARTH.ORG IS POWERED BY OVER 150 CONTRIBUTING WRITERS

Data Centers Are We Prepared?

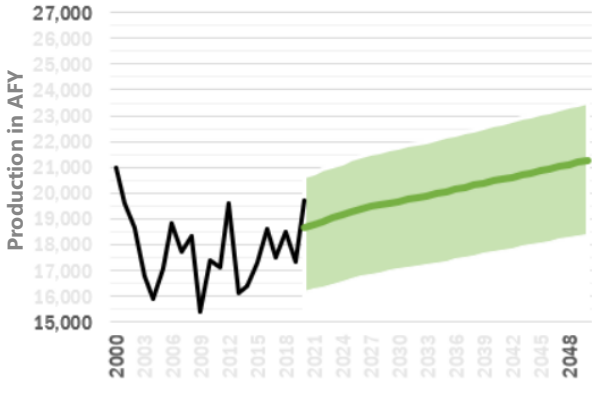


Dylan Poulsen works on a server at Meta's Eagle Mountain Data Center in Eagle Mountain on Friday, Sept. 30, 2022. Meta is expanding the data center, increasing the total investment to over $1.5 billion. Once completed, the center will be a 4.5-million-square-foot campus.

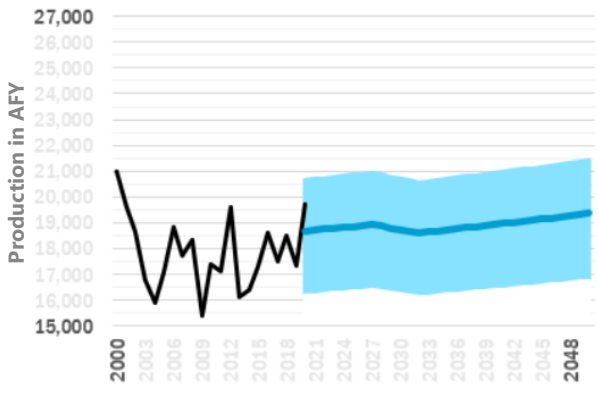
Spectrum of Demand Forecasting Techniques

Scenario Planning Framework

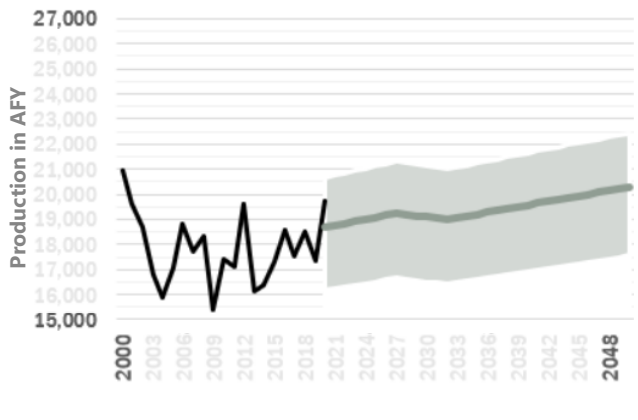
On Trend



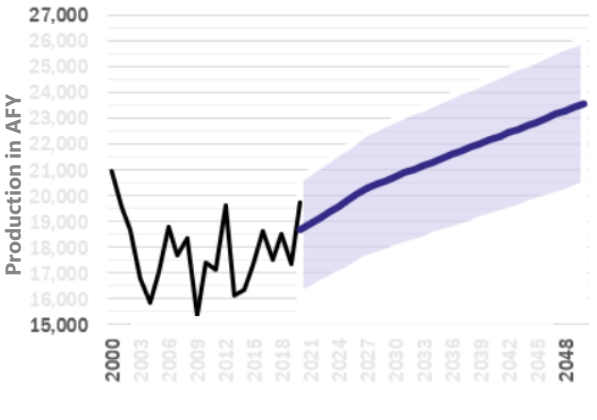
On Trend with Outdoor Conservation



Warmer, Dense, and More Outdoor Conservation



Hotter and Max Growth



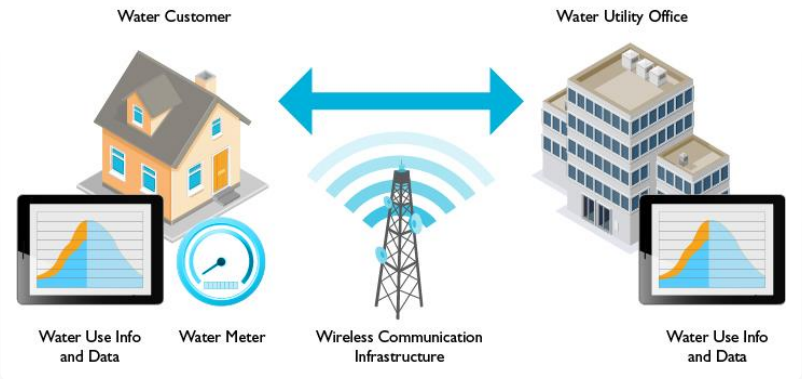
AWWA's Guidebook – Practical and FREE

- Presents resources to process **downscaled climate change data**
- Overview of **key areas of water demand** impacted by climate change
- **Methods** for incorporating into forecasts
- **Case studies**

https://www.awwa.org/wp-content/uploads/Incorporating-Climate-Change-Impacts-Into-Demand-Forecasting.pdf

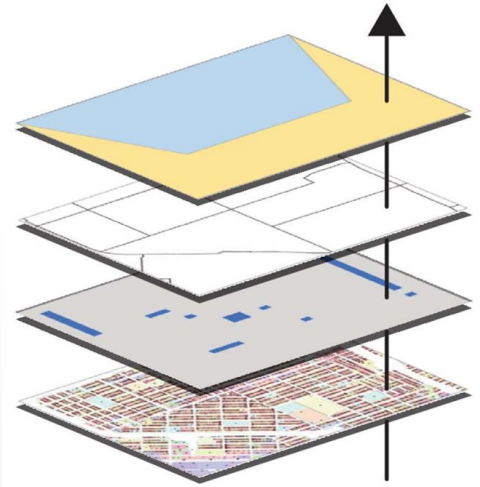
The Age of Digital Transformation

AMI



CLIMATE

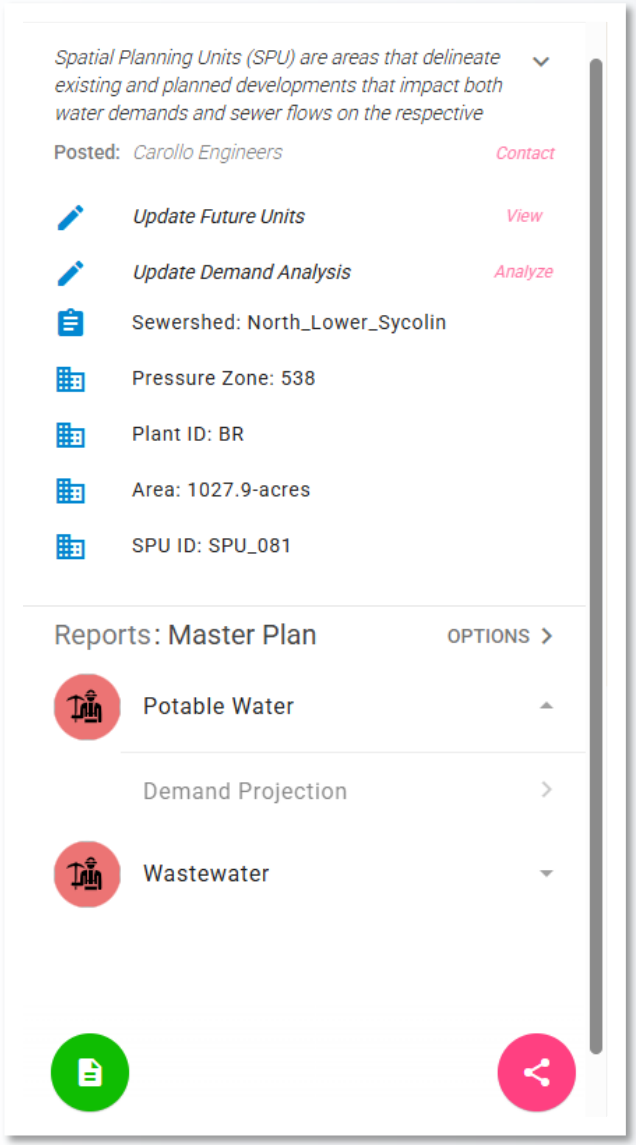
SPATIAL

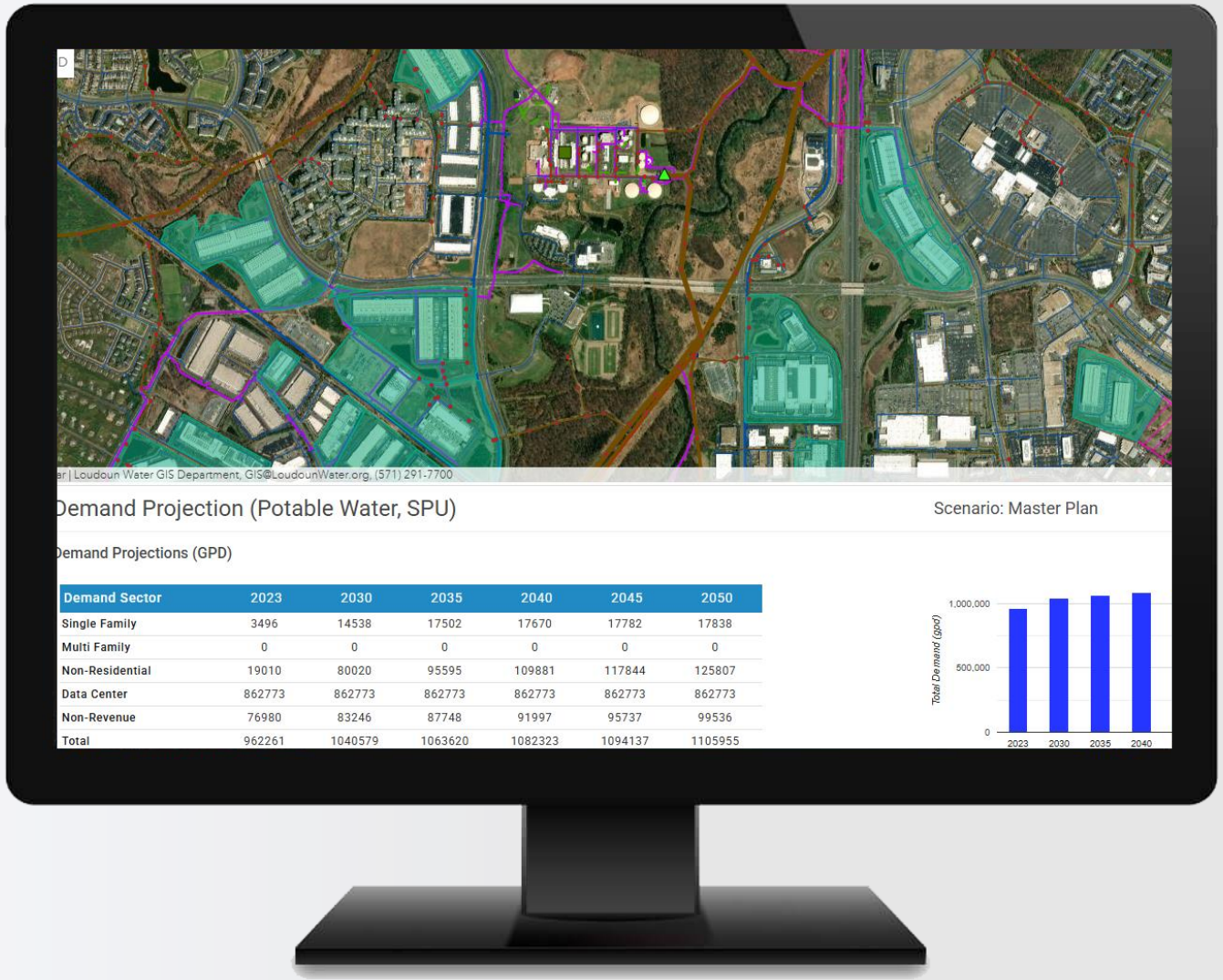


ADVANCED PROCESSING

```
        vars1 = [vars[0]]
        vars2 = [vars[1:(len(vars)+1)]]

    # set ylabs
    if ylab1 is None: ylab1 = vars1
    if ylab2 is None: ylab2 = vars2

    # set up plot settings
    plt.style.use('default')
    fig, ax1 = plt.subplots(figsize=(10, 5))

    # plot 1st vars
    ax1.set_xlabel(xlab)
    ax1.set_ylabel(ylab1, color=clr1)

    # iterate through variables
    for ind, v in enumerate(vars1):
        clr = clr1
        if ind > 0: clr = clrs(ind)
        ax1.plot(df.index, df[v], label=v, linestyle='-', color=clr)
```

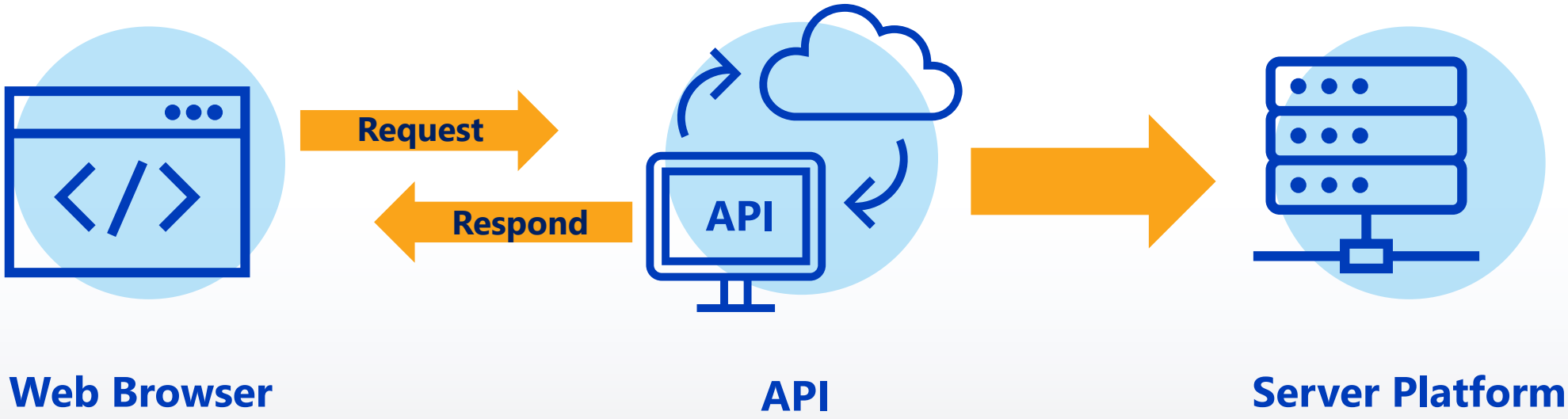
Dashboards and Planning Tools





Where is demand forecasting headed?

Quicker, Automated Data Collection and Processing to Support Forecasting



Digital Intelligence

Take Aways

- Sophisticated **mathematical techniques** have been around a long time
- **Data have expanded** and advanced in every way possible
- **Tools and resources** for processing the data are catching up
- **New generation of engineers** and **planners** with matching skills
- **Automation of forecasting** to do the work more efficiently

A Discussion with

Colwyn Sunderland

Infrastructure Planning Engineer
Kerr Wood Leidal

Jessica Fritsche

Senior Planner
Carollo Engineers

Reminders & What's Next

Thank you all for participating in this session!

- **CEUs:** AWWA CA-NV Water Use Efficiency Practitioner

American Water Works Association
California-Nevada Section

- **Next:** Closing Plenary (3:15 – 3:30 pm)
- **Field Trip Reminder:** Meet in Gleacher Center Lobby immediately after Closing Plenary. **Bus leaves at 3:45 pm**

WATER EFFICIENCY & CONSERVATION SYMPOSIUM

Thank You to Our Sponsors