The Future of California's Water-Energy-Climate Nexus

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Today's Briefing

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Motivations and Objectives for Report

- CA is not on track to meet its 2030 greenhouse gas (GHG) emissions targets and the energy-intensive water sector can play a role in meeting climate goals.

- Several trends in climate, water sources, and water demands will affect water-related GHGs but their combined impact is not well understood.

Report objective:

- Estimate the energy and GHG footprint of CA's urban and agricultural water sectors, under various future water demand and supply scenarios

Scope of Analysis

1. Comprehensive assessment of the energy and GHG footprint related to water in California

2. Case studies highlighting risks and opportunities associated with water-related energy use and GHG emissions

3. Policy recommendations for reducing California's water-related energy and GHG footprint

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Background: CA Water, Energy, & GHGs Closely Linked

- California's water, from collection and distribution to use and wastewater treatment, is responsible for:
  - About 20 percent of total statewide electricity use
  - A third of non-power-plant natural gas consumption
  - 88 billion gallons of diesel consumption
  - The State Water Project is the single largest electricity user in the state
- Water-related energy use has implications for CA's GHGs

Background: CA Water Demands and Supplies are Changing

- California continues to face drought conditions and constraints on water supply
- Urban water
  - Growing population but declining per-capita water use
  - Shifting water supply to more local sources with varying energy intensities
- Agricultural water
  - Water use flat but greater reliance on groundwater and subsequent declining groundwater levels

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Report Key Takeaways

- Water-related energy and GHGs are driven by total water use and the mix of sources, and will increase under current or increased per-capita water use scenarios.
- Urban water-efficiency offers the greatest reductions in water-related energy use and GHG emissions.
- Decarbonization coupled with greater electrification of end-uses (water heaters) can also accelerate reductions in water-related GHG emissions.
- Agricultural water use is far greater than that of CA's urban sector, but urban water is 9x more energy-intensive and produces 9x more GHG emissions.
- Restoration of groundwater levels and reduced pumping can cut the energy use of agricultural water.

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RESEARCH DESIGN

Analysis & Methodology

Methodology

1. Identify the energy intensities associated with each stage of the water management cycle,
2. Calculate the GHG intensity of each energy source related to water,
3. Develop scenarios of future water supplies and demands for the urban and agricultural sectors,
4. Apply the energy and GHG intensities to historical water use and each scenario of future water use, and
5. Offer policy recommendations to reduce energy and GHG footprint related to water.

Embedded Energy in the Water Cycle

Figure 1 Stages of the Water Cycle with Embedded Energy

Examples:

Groundwater pumping

Source: Maven's Notebook

State Water Project

Source: DWR

Drinking water treatment

Source: SCVWD

Urban water distribution

Source: SDCWA

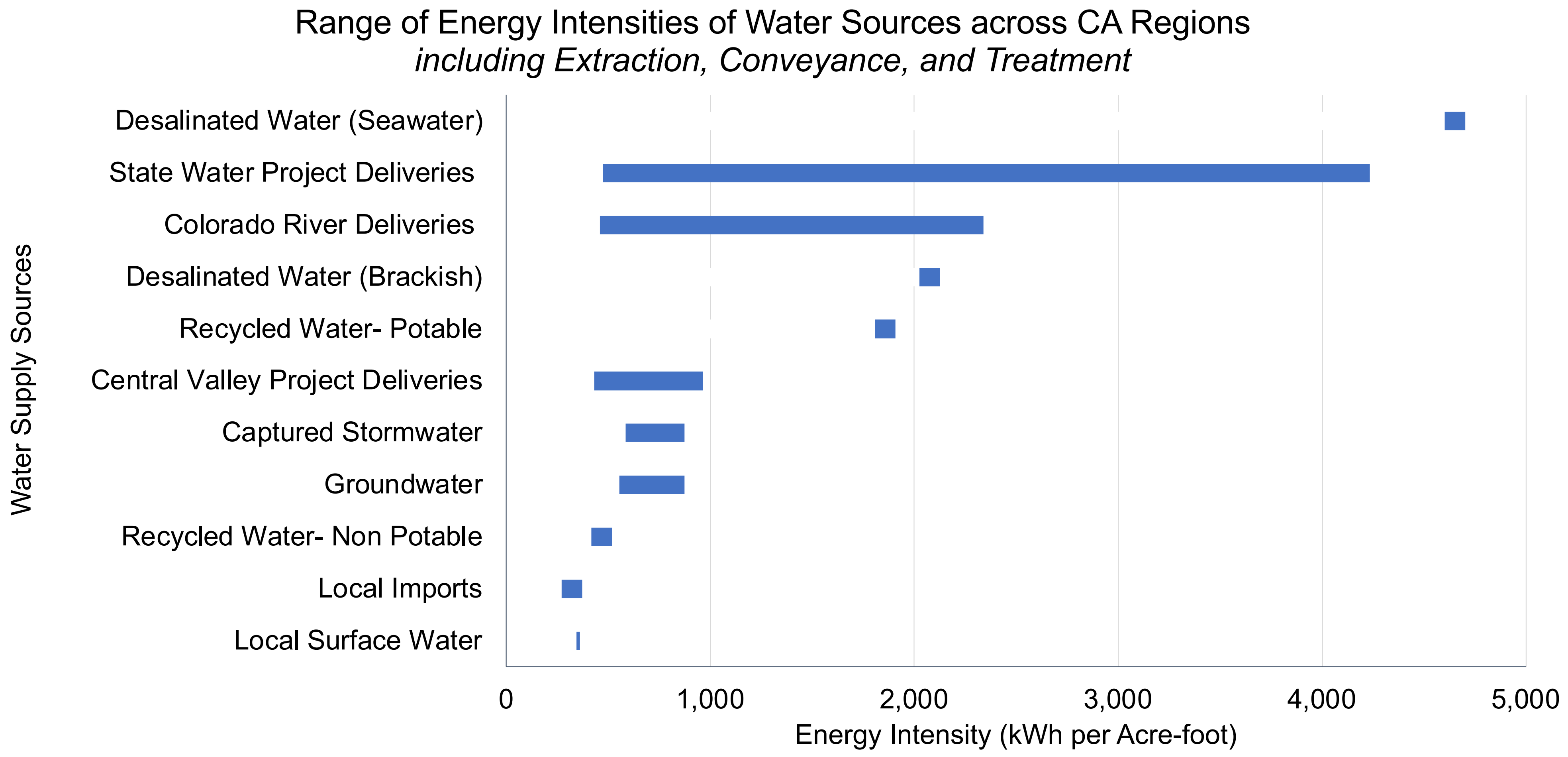
Residential water heating

Source: DOE

Wastewater Treatment

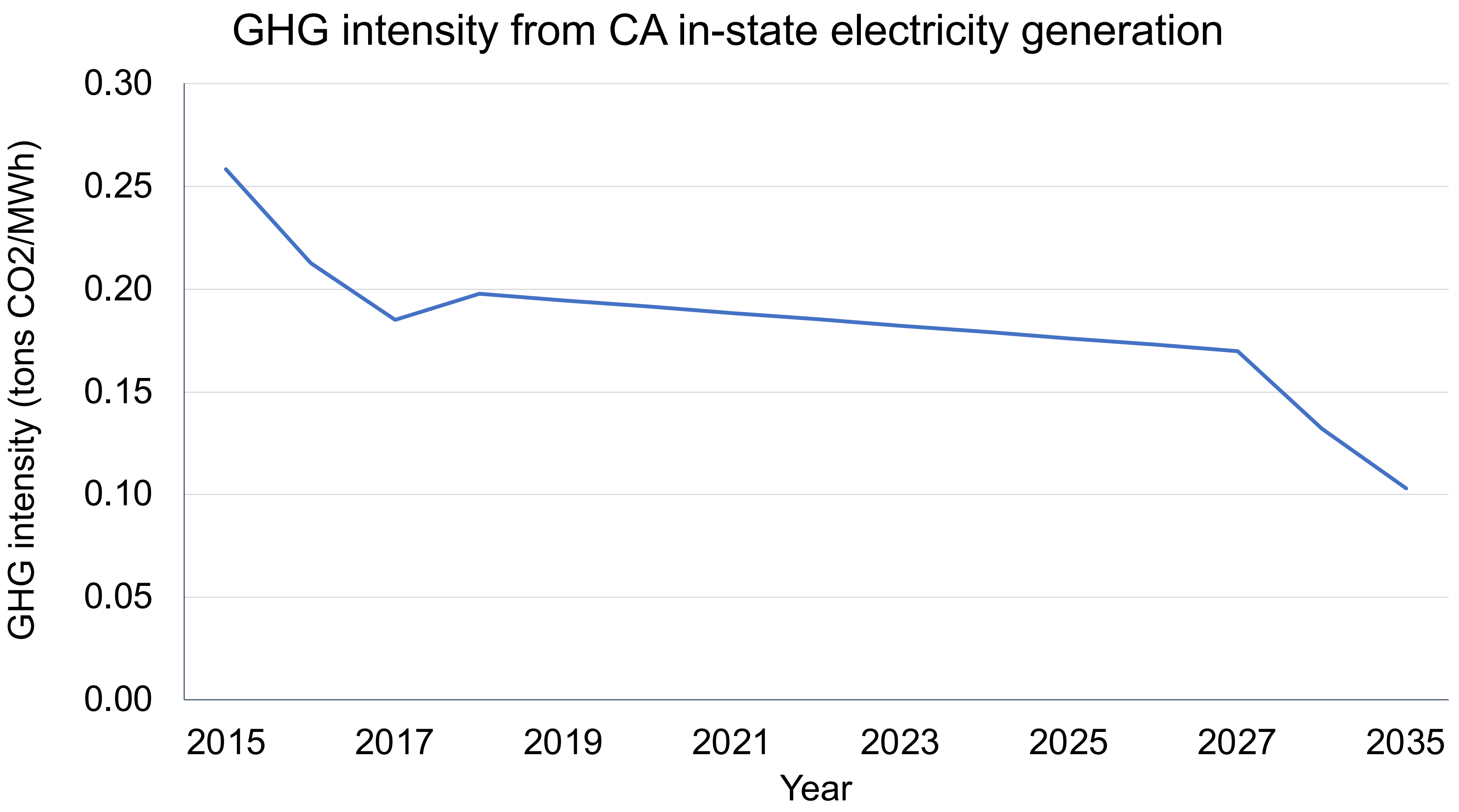
Source: EDBMUD

Energy Intensity of CA Water Supply



Source: Adapted from Table 4 in Report

GHG Intensity of CA Water Cycle



Source: Adapted from Table 5 in Report

Future Water Demand and Supply Scenarios

- Demand scenarios for 2020, 2025, 2030, 2035 by region
- Supply mix as given from water suppliers' plans and DWR, by region

Urban

- **Low:** Decreasing 2% per-cap demand per year
- **Mid:** 2015 per-cap demand
- **High**: Growing per-cap demand per water suppliers

Source: 2015 Urban Water Management Plans

* 90% of statewide population

Agricultural

- **Low**: High urban growth, greatest climate impact
- **Mid**: Mid urban growth
- **High**: Low urban growth, lowest climate impact

Source: 2018 CA Water Plan Update, DWR

* Central Valley Hydrologic Regions

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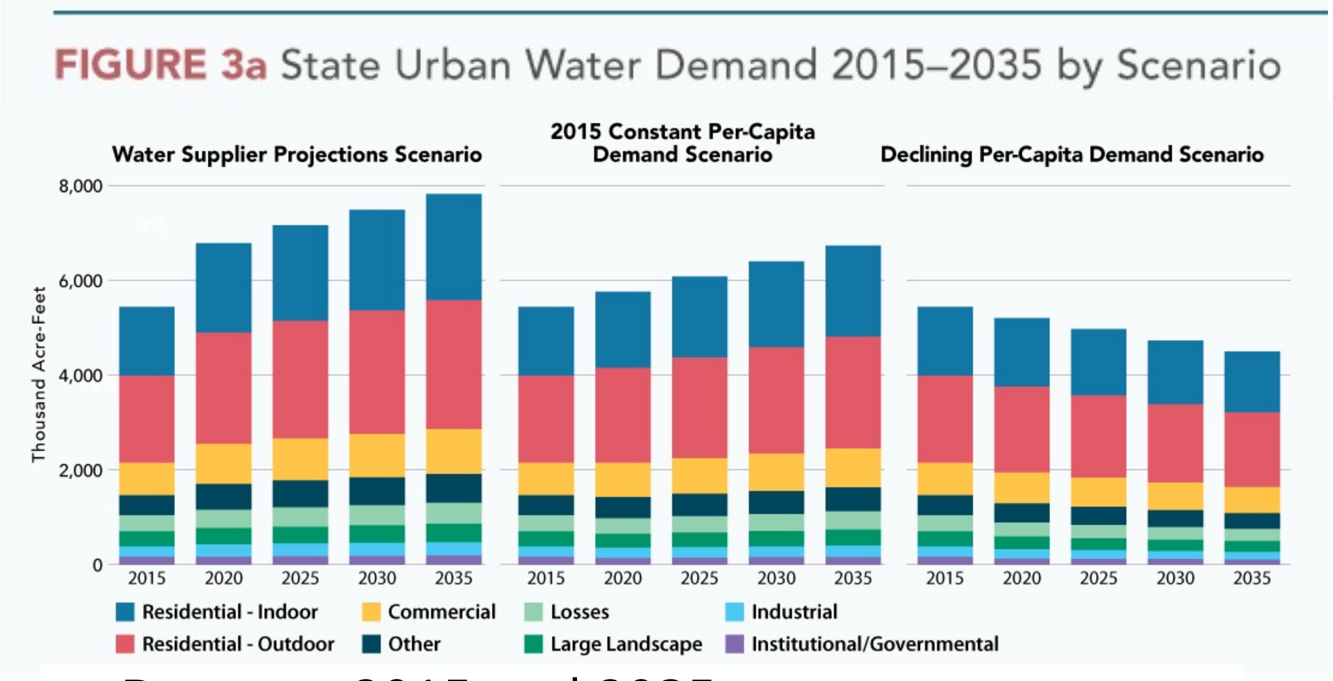
SCENARIO ANALYSIS RESULTS

1. Urban
2. Agricultural

Urban Water Demand and Supply Results



- Between 2015 and 2035:

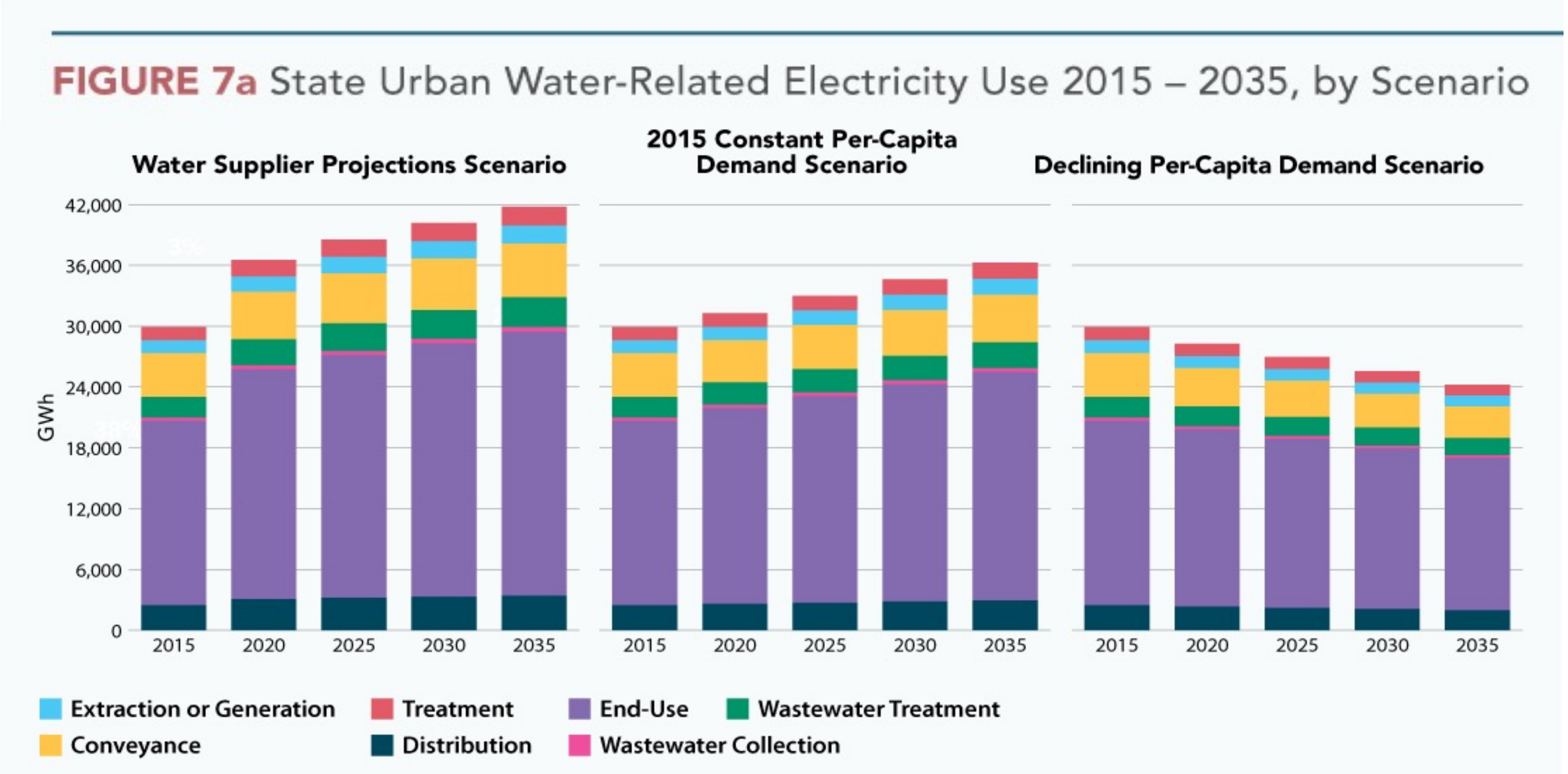
High:	Mid:	Low:
+44%	+24%	-17%

- Largest increase in residential use

Water supply:

- Largest absolute increase in surface + groundwater
- Largest % increase in recycled water, brackish desal, stormwater
- Decrease in share of imports to Southern CA

Urban Water Electricity Use Results



- Between 2015 and 2035:

High:	Mid:	Low:
+40% elec.,	+21% elec.,	-19% elec.,
+45% gas	+25% gas	-16% gas

Urban Water GHG Emissions Results

Table 18: GHG Emissions Related to CA Urban Water

Scenario	Fuel	% Change 2015-2035
Water Supplier Projections Scenario (High-Case)	Electricity	-44%
	Natural Gas	45%
	Total	2%
2015 Constant Per-Capita Demand Scenario (Mid-Case)	Electricity	-52%
	Natural Gas	25%
	Total	-12%
Declining Per-Capita Demand Scenario (Low-Case)	Electricity	-68%
	Natural Gas	-16%
	Total	-41%

- Largest driver of GHG emissions is energy-intensive water heating, which is primarily with natural gas in CA

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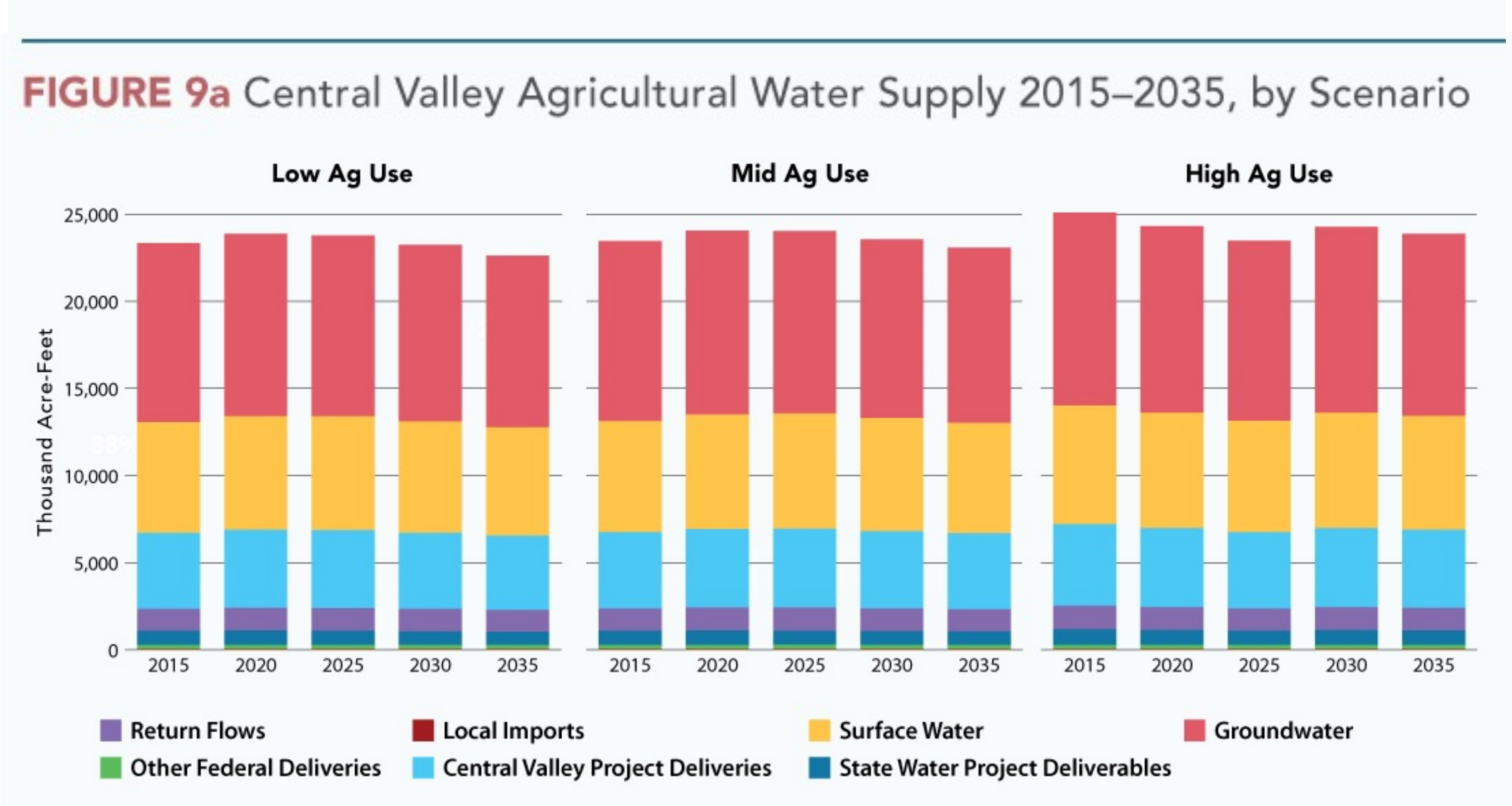
Central Valley Ag Water Supply Scenarios



Between 2015 and 2035:

- -2% to -5% in overall water deliveries, driven by urban growth (SGMA not explicitly included)
- Largest absolute decreases from State Water Project & groundwater

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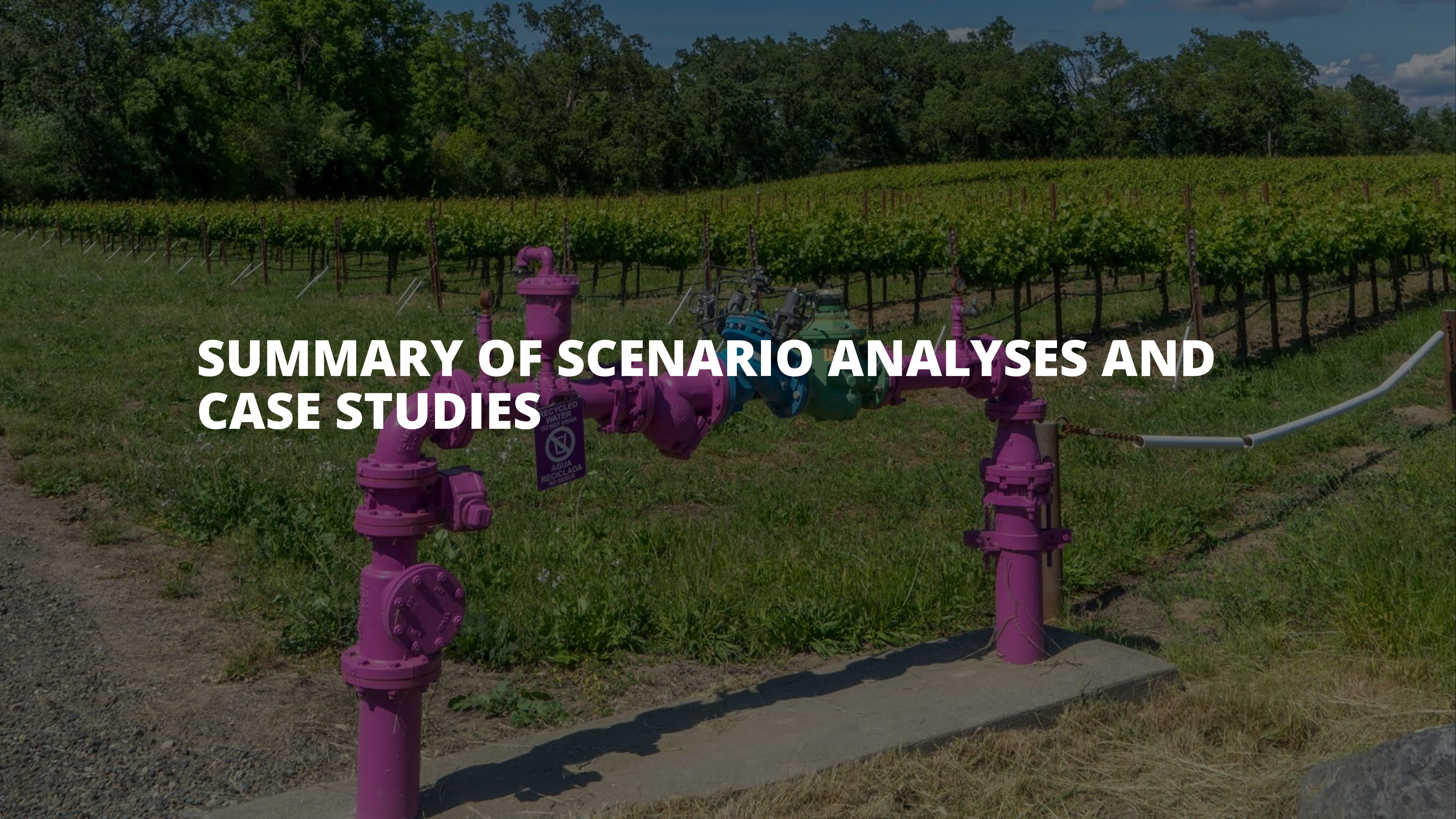
Central Valley Ag Water-Related GHG Emissions

- Electricity -4% to -6% across scenarios
- Decarbonization and decreasing water demand together reduce GHG emissions from agricultural water system by ~60%.
- No emissions from natural gas, diesel, or other fuels included.

Electricity use and GHG Emissions Related to Central Valley Ag Water

	Electricity use	GHG Emissions
Level of Ag Use	**% Change 2015-2035**	**% Change 2015-2035**
Low Ag Water Use	-5%	-62%
Mid Ag Water Use	-4%	-62%
High Ag Water Use	-6%	-62%

SUMMARY OF SCENARIO ANALYSES AND CASE STUDIES



Urban Scenario Results

Estimated Urban Water-Related Energy and Greenhouse Gas (GHG) Impacts, 2015-2035

Change from 2015-2035	Declining Per-Capita Demand Scenario (Low-Case)	2015 Constant Per-Capita Demand Scenario (Mid-Case)	Water Supplier Projections Scenario (High-Case)
Urban Water Demand	-17%	+24%	+44%
Water-Related Electricity Use	-19%	+21%	+40%
Water-Related Natural Gas Use	-16%	+25%	+45%
GHG Emissions From Urban Water-Related Energy Use	-41%	-12%	+2%

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Agricultural Scenario Results

Estimated Central Valley Agricultural Water-Related Energy and Greenhouse Gas (GHG) Impacts, 2015-2035

Change from 2015-2035	Low Ag Water Use Scenario	Mid Ag Water Use Scenario	High Ag Water Use Scenario
Agricultural Water Supply Delivered	-3%	-2%	-5%
Water-Related Electricity Use	-5%	-4%	-6%
GHG Emissions From Agricultural Water-Related Energy Use	-62%	-62%	-62%

Urban and Agricultural Case Studies

- **LADWP's shift to recycled and local sources**
  - Shifting from imported water from Northern CA and the Colorado River to local sources, especially stormwater and recycled water, saves energy.
- **Energy Recovery at EBMUD's Wastewater Treatment Plant**
  - Plant produces more energy than needed to run it, saving $2.5 million in energy costs and generating $750,000 in revenues by selling excess energy to the grid.
- **Sustainable Groundwater Management Act (SGMA) impacts on pumping energy**
  - Declining groundwater levels increase pumping energy use by 11% to 26%, depending on pump efficiency.

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POLICY RECOMMENDATIONS

Policy Recommendations

Expand urban water conservation and efficiency efforts.

Accelerate water heater electrification.

Restore groundwater levels and expand more flexible, high-efficiency groundwater pumps.

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Policy Recommendations

Provide financial incentives and regulatory pathways for water suppliers to invest in less energy- and GHG-intensive water systems.

Expand water data reporting and energy usage tracking.

Formalize coordination between water and energy regulatory agencies and utilities.

QUESTIONS & ANSWERS

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