The Future of California’s Water-Energy-Climate Nexus
Today’s Briefing

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Director of Research, Next 10
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
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
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.
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

<table>
<thead>
<tr>
<th>Managed water cycle stages with embedded energy:</th>
<th>Treated wastewater for recycling</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Supply Extraction/Generation</td>
<td>5. End-Use</td>
</tr>
<tr>
<td>2. Conveyance</td>
<td>6. Wastewater Collection</td>
</tr>
<tr>
<td>3. Treatment</td>
<td>7. Wastewater Treatment</td>
</tr>
<tr>
<td>4. Distribution</td>
<td></td>
</tr>
</tbody>
</table>

Energy embedded in water supplies

Energy embedded in water demands

**Examples:**

- Groundwater pumping
- State Water Project
- Drinking water treatment
- Urban water distribution
- Residential water heating
- Wastewater Treatment

Sources:

- Groundwater pumping: Maven's Notebook
- State Water Project: DWR
- Drinking water treatment: SCVWD
- Urban water distribution: SDCWA
- Residential water heating: DOE
- Wastewater Treatment: EDBMUD
Energy Intensity of CA Water Supply

Range of Energy Intensities of Water Sources across CA Regions
including Extraction, Conveyance, and Treatment

Water Supply Sources:
- Desalinated Water (Seawater)
- State Water Project Deliveries
- Colorado River Deliveries
- Desalinated Water (Brackish)
- Recycled Water - Potable
- Central Valley Project Deliveries
- Captured Stormwater
- Groundwater
- Recycled Water - Non Potable
- Local Imports
- Local Surface Water

Energy Intensity (kWh per Acre-foot)

Source: Adapted from Table 4 in Report
GHG Intensity of CA Water Cycle

GHG intensity from CA in-state electricity generation

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

Agricultural

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

Source: 2015 Urban Water Management Plans
* 90% of statewide population

Source: 2018 CA Water Plan Update, DWR
* Central Valley Hydrologic Regions
SCENARIO ANALYSIS RESULTS

1. Urban
2. Agricultural
Urban Water Demand and Supply Results

Water supply:

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

Between 2015 and 2035:

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

Largest increase in residential use
Urban Water Electricity Use Results

**FIGURE 7a State Urban Water-Related Electricity Use 2015 – 2035, by Scenario**

- **Between 2015 and 2035:**
  - **High:** +40% elec., +45% gas
  - **Mid:** +21% elec., +25% gas
  - **Low:** -19% elec., -16% gas
Urban Water GHG Emissions Results

Table 18: GHG Emissions Related to CA Urban Water

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Fuel</th>
<th>% Change 2015-2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Supplier Projections Scenario (High-Case)</td>
<td>Electricity</td>
<td>-44%</td>
</tr>
<tr>
<td></td>
<td>Natural Gas</td>
<td>45%</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>2%</strong></td>
</tr>
<tr>
<td>2015 Constant Per-Capita Demand Scenario (Mid-Case)</td>
<td>Electricity</td>
<td>-52%</td>
</tr>
<tr>
<td></td>
<td>Natural Gas</td>
<td>25%</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>-12%</strong></td>
</tr>
<tr>
<td>Declining Per-Capita Demand Scenario (Low-Case)</td>
<td>Electricity</td>
<td>-68%</td>
</tr>
<tr>
<td></td>
<td>Natural Gas</td>
<td>-16%</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>-41%</strong></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Level of Ag Use</th>
<th>Electricity Use % Change 2015-2035</th>
<th>GHG Emissions % Change 2015-2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Ag Water Use</td>
<td>-5%</td>
<td>-62%</td>
</tr>
<tr>
<td>Mid Ag Water Use</td>
<td>-4%</td>
<td>-62%</td>
</tr>
<tr>
<td>High Ag Water Use</td>
<td>-6%</td>
<td>-62%</td>
</tr>
</tbody>
</table>
SUMMARY OF SCENARIO ANALYSES AND CASE STUDIES
## Urban Scenario Results

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

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

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

<table>
<thead>
<tr>
<th>Change from 2015-2035</th>
<th>Low Ag Water Use Scenario</th>
<th>Mid Ag Water Use Scenario</th>
<th>High Ag Water Use Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural Water Supply Delivered</td>
<td>-3%</td>
<td>-2%</td>
<td>-5%</td>
</tr>
<tr>
<td>Water-Related Electricity Use</td>
<td>-5%</td>
<td>-4%</td>
<td>-6%</td>
</tr>
<tr>
<td>GHG Emissions From Agricultural Water-Related Energy Use</td>
<td>-62%</td>
<td>-62%</td>
<td>-62%</td>
</tr>
</tbody>
</table>
• **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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• 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.
Policy Recommendations

Expand urban water conservation and efficiency efforts.

Accelerate water heater electrification.

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