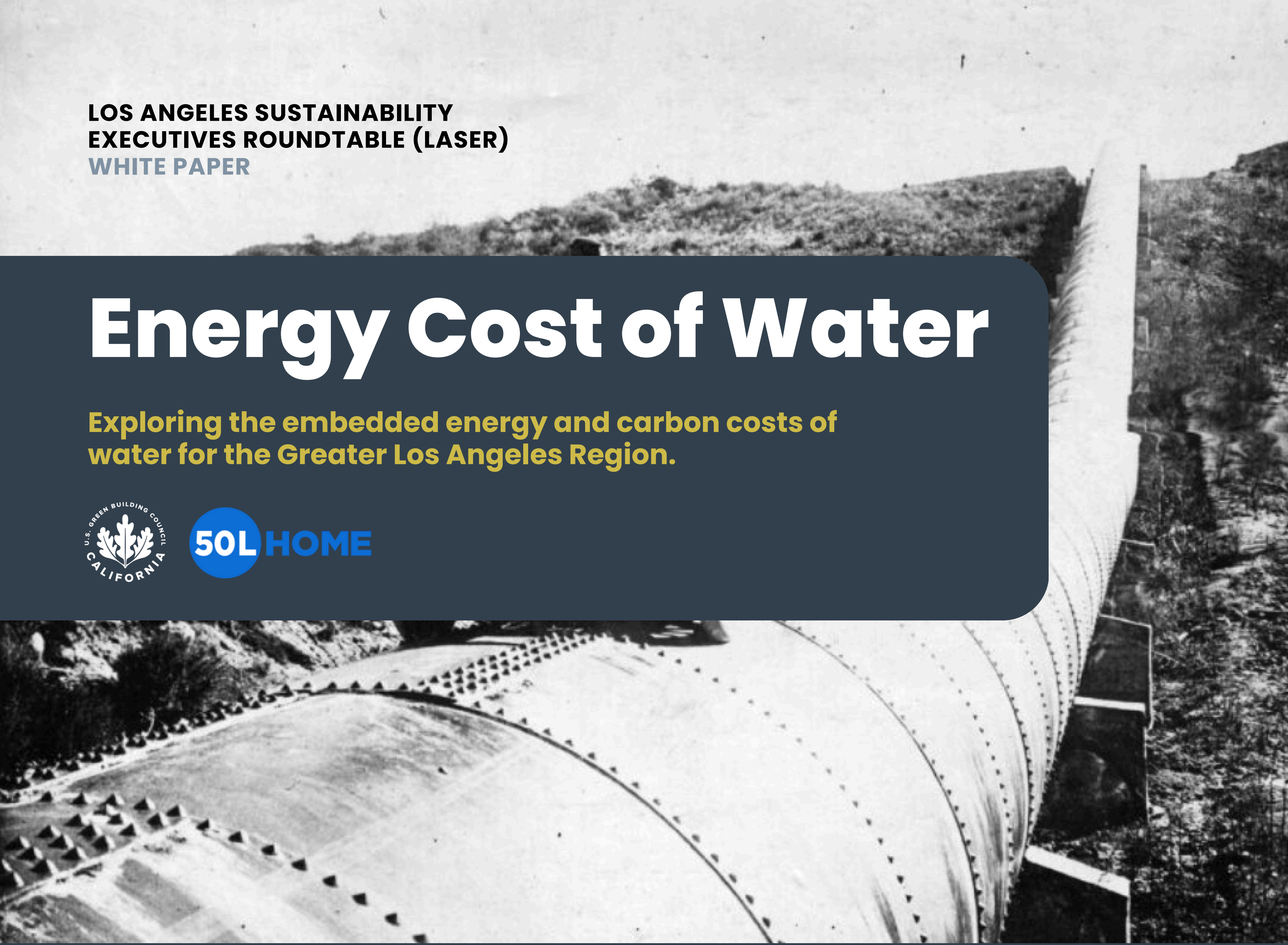

LOS ANGELES SUSTAINABILITY EXECUTIVES ROUNDTABLE (LASER)

WHITE PAPER

Energy Cost of Water

Exploring the embedded energy and carbon costs of water for the Greater Los Angeles Region.

October, 2023

ACKNOWLEDGEMENTS

CONTRIBUTORS

Kenshin Ueoka, USGBC-CA Green Building Corps

Ben Baraga, USGBC-CA Green Building Corps

George Lu, USGBC-CA Sr. Advisor, Corporate Sustainability & ESG

Pars Parikh, USGBC-CA Program Coordinator

Ben Stapleton, USGBC-CA Executive Director

Clarisse Cao, USGBC-CA Green Building Corps

LASER LEADERSHIP COMMITTEE

Ben Stapleton	**Natalie Teear**	**Zoe Koskinas**
Nurit Katz	**Rick Duarte**	**Amit Jain**
Lisa Day	**Holly Hill**	**Nick Caton**
Maria Sison-Roces	**Carlo Gavino**	**Becky Feldman Edwards**

SPECIAL THANKS TO OUR REVIEWERS

Rosa Castro	**Jin Hwang**	**Terrence McCarthy**
Heather Cooley	**Theresa Kim**	**Samantha McLelland**
Maureen Erbeznik	**Bill McDonnell**	**Ratish Namboothiry**

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EXECUTIVE SUMMARY

This white paper delves into the critical interplay between water resource management and sustainable development in the arid landscape of Southern California, with a specific focus on Los Angeles. It **emphasizes the importance of understanding the hidden energy and carbon costs associated with water usage**, which goes beyond conventional metrics like utility bills.

The region relies heavily on the Los Angeles Aqueduct (LAA) and imported water sources. While the LAA's energy intensity is considerably low, imported sources have high energy costs associated with long-distance conveyance. Similarly, recycled water, though increasing water security, is highly energy-intensive. Yet, more energy-efficient recycling methods may become crucial for the region's resilience as water supply uncertainty grows. This paper also **translated the energy costs into the carbon footprint of Los Angeles' water supply to identify the carbon associated with water sources**.

The discussion moves to the building-level water-related energy use and identifies the most significant warm water uses. This highlights the importance of both behavioral water conservation efforts as well as the implementation of high-efficiency fixtures in showers and faucets. The **final section offers practical guidance on best practices for water conservation**, demonstrating that energy savings and carbon emissions reductions are attainable through upgrades such as high-efficiency fixtures, stormwater capture, and native landscaping. These efforts not only reduce environmental impact but also save money for businesses and households through energy cost savings and rebates.

INTRODUCTION

The relentless challenges posed by climate change have cast a spotlight on the critical interplay between water resource management and sustainable development. In the arid landscape of Southern California, where the delicate equilibrium of water availability is regularly disrupted by the twin specters of floods and droughts, the significance of efficient water utilization cannot be overstated. This white paper is a comprehensive effort by USGBC California to delve into a crucial, but often overlooked aspect of water management – the embedded energy and carbon costs associated with water usage.

The **primary objective** of this paper is to meticulously identify and quantify the often concealed energy and carbon expenditures linked to water use within Southern California, with a specific focus on the Los Angeles metropolitan area. While the conventional metrics of water usage are prominently manifested in utility bills, they merely scratch the surface of the intricate narrative that underpins the complex water dynamics of the LA area.

Southern California stands as a microcosm of the global water crisis. The confluence of climatic vulnerabilities and

Source: Water and Power

INTRODUCTION

rapid urbanization exacerbates the region's susceptibility to both excesses and deficits in water supply. The damaging oscillation between floods and droughts not only disrupts daily life but also poses existential threats to local commerce and livelihoods. Amidst these challenges, the scarcity of water looms large as a pervasive concern.

Comprehending a greater extent of water's impact necessitates a paradigm shift – one that integrates the dimensions of energy and carbon costs into the analysis. The endeavor to recognize the hidden energy and carbon footprints of water usage redefines the conventional narrative. Through this expanded lens, utility bills emerge as just a segment of the comprehensive account of water resource management.

This paper focuses on **the energy during the source conveyance, treatment, distribution, and end-use nodes of the lifecycle of water, with limited analysis of wastewater**. We acknowledge that downstream water management may have a sizeable energy impact, but this topic requires a separate future in-depth review.

By assimilating the energy and carbon costs within the broader water framework, this paper seeks to catalyze enhanced water conservation practices. By augmenting the analysis with the energy dimension, strategies for reducing water use are emboldened. The viability of approaches like stormwater capture, water recycling, and reuse require renewed substantiation. Such practices foster sustainable water utilization and mitigate energy-related impacts, simultaneously addressing two intertwined sustainability dimensions.

This research amalgamates water use data and energy statistics from authoritative sources such as the Pacific Institute, the Los Angeles Department of Water and Power (LADWP), and the Metropolitan Water District of Southern California (MWD). This rigorous approach assures the integrity and accuracy of the conclusions drawn.

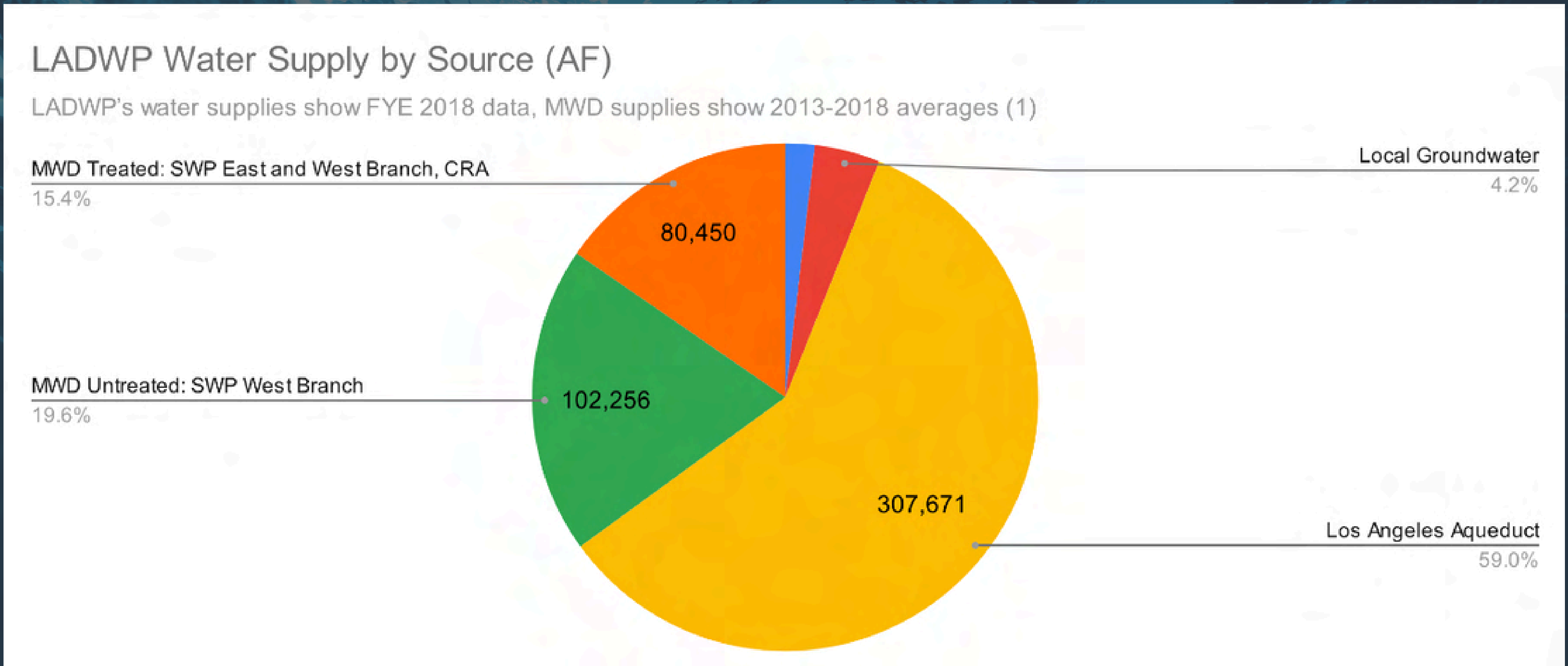
SECTION 1: THE REGION

Source: [Public Works, Los Angeles County]

We begin with a discussion on the overall breakdown of the energy cost of water at the regional level, identifying the most energy-intensive parts of the lifecycle of the water, and then zooming into the conveyance and distribution of water to and within Los Angeles.

Then we translate the energy costs to carbon costs and have a qualitative discussion on the externalities associated with LA's water.

Overview of LADWP Water Supply Sources



The city's water supply is composed of local and imported sources. Local sources (6%) include recycled water and local groundwater. In comparison, imported sources (94%) include the Los Angeles Aqueduct (LAA), untreated water from the State Water Project (SWP) west branch, and treated water from the SWP and the Colorado River Aqueduct (1). The California State Water Project (SWP) is a statewide water delivery system conveying water from Northern California to both the Bay Area and Southern California. As a regional wholesaler, the MWD owns and operates the CRA, is a SWP contractor, and serves 26 member agencies within a 5,200-square-mile service area in Southern California. LADWP receives imported water supplies from MWD since the city of Los Angeles is an MWD member agency.

Overview of LADWP Water Supply Sources

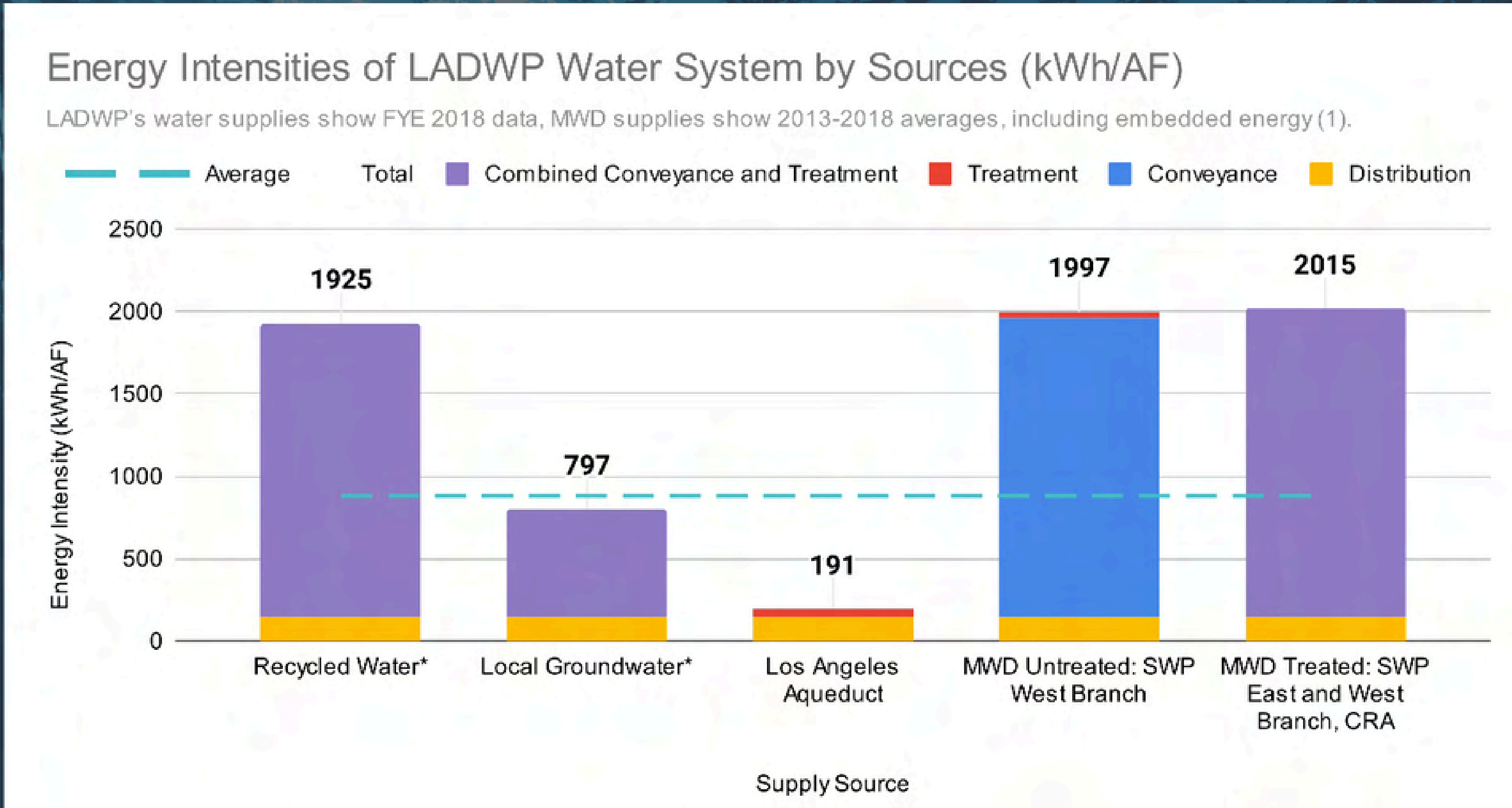
Imported water sources have sustained LA for decades. However, this reliance raises questions regarding the energy costs associated with water conveyance over long distances, as well as the risks pertaining to self-sufficiency and water security — especially in an era characterized by shifting climate patterns and potential supply disruptions.

Recycled water constitutes a mere 1.9% of the total water supply. Although this water source increases water security in the face of a drought, it is also highly energy intensive. Expanding energy-efficient water recycling methods will bolster our region's resilience as we confront an era marked by heightened water supply uncertainty.

It's important to emphasize that the data presented here is specific to the service area of the Los Angeles Department of Water and Power (LADWP). In 2018 alone, the city of Los Angeles consumed a staggering total of 522,115 acre-feet of water (about 260,000 Olympic-sized swimming pools), underscoring the scale of the water challenges faced by our metropolis. In the subsequent sections of this whitepaper, we will delve deeper into the implications of LA's water supply sources on our sustainability efforts, environmental impact, and long-term strategic planning.

Source: Water and Power

Energy Intensities of LADWP Water System by Sources



*Segmentations are difficult to make for recycled water and ground water, as they are treated immediately upon extraction.

Next, we compare the relative energy intensities of the water supply sources (1).

We immediately notice that the LAA emerges as a standout in terms of energy efficiency. The LAA's energy intensity for conveyance is notably low. The 191 kWh/AF energy intensity does not account for the energy generated along the aqueduct since the energy generated is not directly used in providing the City's other sources of water supply. When accounting for the hydroelectricity generated during the water conveyance process, the LAA transforms into an energy-positive source. In essence, the LAA not only provides water but also contributes surplus energy to the grid, rendering its net energy intensity negative. This positive impact

Energy Intensities of LADWP Water System by Sources

underscores the significance of the LAA in the City's water supply, with 59% of LA's water sourced from this relatively low-energy conduit.

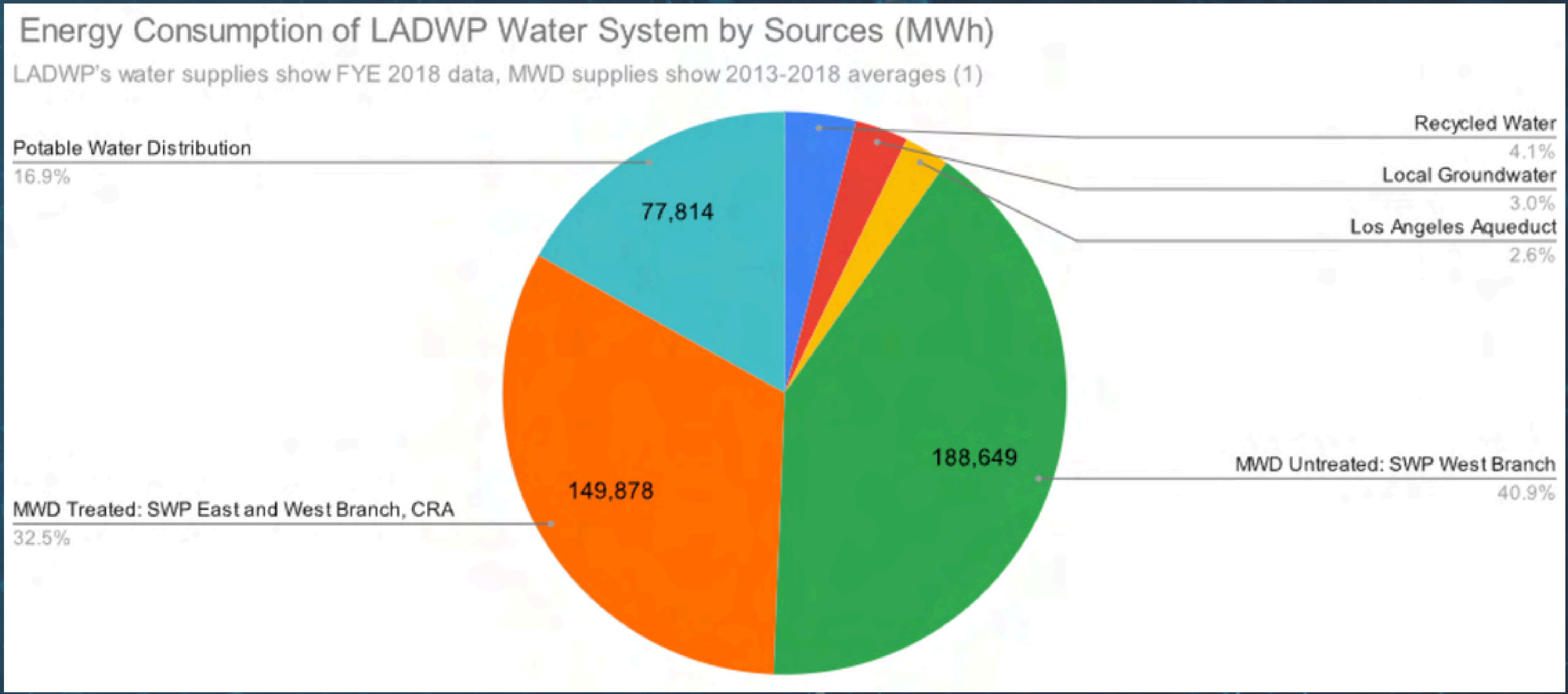
However, the energy intensities of other imported water sources tell a different story. Water imported from the MWD carries a considerably higher energy intensity, near 2000 kWh/AF. These energy intensities apply to SWP deliveries to MWD's service area and include conveyance, treatment (for treated water), and distribution, with the bulk of emissions coming during the conveyance phase. This level of energy consumption is close to that of recycled water, which registers at 1925 kWh/AF.[1] This highlights the need for continual efforts to optimize energy efficiency in our water supply infrastructure, especially when dealing with large-scale water conveyance systems.

Source: State of California, Department of Water Resources

In the context of LADWP's infrastructure serving four million residents and local businesses in the city of LA, it is essential to recognize the scale of our water distribution network (3). This intricate infrastructure plays a crucial role in ensuring that the water we source, whether locally or imported, reaches residents and businesses efficiently and reliably. Overall, regardless of the origin source of water, the City's vast network of 7,340 miles of distribution mains and trunk lines, deliver water to the end user at an average energy intensity of about 883 kWh/AF.

1 When we expand the scope to compare Southern California's energy intensity to the rest of the USA, the SWP still emerges as a high-energy source, using 3280 kWh/AF for conveyance (2).

Energy Consumption of LADWP Water System by Sources



Now we combine the water supply distribution and the energy intensity of each to compute the total energy consumption associated with each source to gain a comprehensive view of the energy demands of our water value chain. In 2018, the total energy consumption for water delivered in Los Angeles amounted to over 460,000 MWh (1).

A significant portion of this energy consumption is attributed to water imports from the MWD through the SWP and CRA, due to the energy embedded in it.[2] These imported water sources account for 73.4% of total energy

2 Embedded energy refers to total energy consumed over the lifecycle of water.

Energy Consumption of LADWP Water System by Sources

expenditure (2018). While these imports are vital to meeting the water needs of our city, their energy-intensive nature underscores the importance of exploring avenues for a balanced strategy that encompasses energy-efficient practices throughout the entire water value chain.

It is worth noting that Potable Water Distribution plays a substantial role in our water value chain. In 2018, it facilitated the conveyance of 512,338 AF of water. This makes distribution the third-largest component of energy consumption within our water supply system. LADWP's extensive network of distribution mains and trunk lines, spanning over 7,000 miles, plays a pivotal role in ensuring the reliable delivery of water to homes, businesses, and industries throughout Los Angeles.

Comparison of Urban System Water Intensity to Other Hydrologic Regions

TABLE 16 Urban Water System Energy Intensity (Electricity) by Hydrologic Region (kWh/AF)

Hydrologic Region	2015	2035	% Change 2015-2035
Central Coast	4,639	4,638	0.0%
Colorado River	2,824	3,056	8.2%
North Coast	5,169	5,170	0.0%
North Lahontan	4,771	4,887	2.4%
Sacramento River	3,485	3,466	-0.5%
San Francisco Bay	5,886	6,104	3.7%
San Joaquin River	4,241	4,215	-0.6%
South Coast	6,356	6,274	-1.3%
South Lahontan	4,102	4,262	3.9%
Tulare Lake	4,101	4,011	-2.2%
State Volume-Weighted Average Urban Energy Intensity	5,507	5,389	-2%

Source: Pacific Institute

Taking a moment to step back and compare the energy intensity figures thus far to that of other parts of California, we turn to the Pacific Institute's data comparing the South Coast hydrologic region to others. South Coast has a broader geographic scope, and thus, the energy intensity is higher than previous values that only examine LADWP's jurisdiction.

South Coast has the most energy-intensive urban water system in all of California, with a value 15% above the average volume-weighted urban energy intensity. Yet, a positive outlook is that the Pacific Institute expects a 2% reduction in urban water system energy intensity between 2015 and 2035.

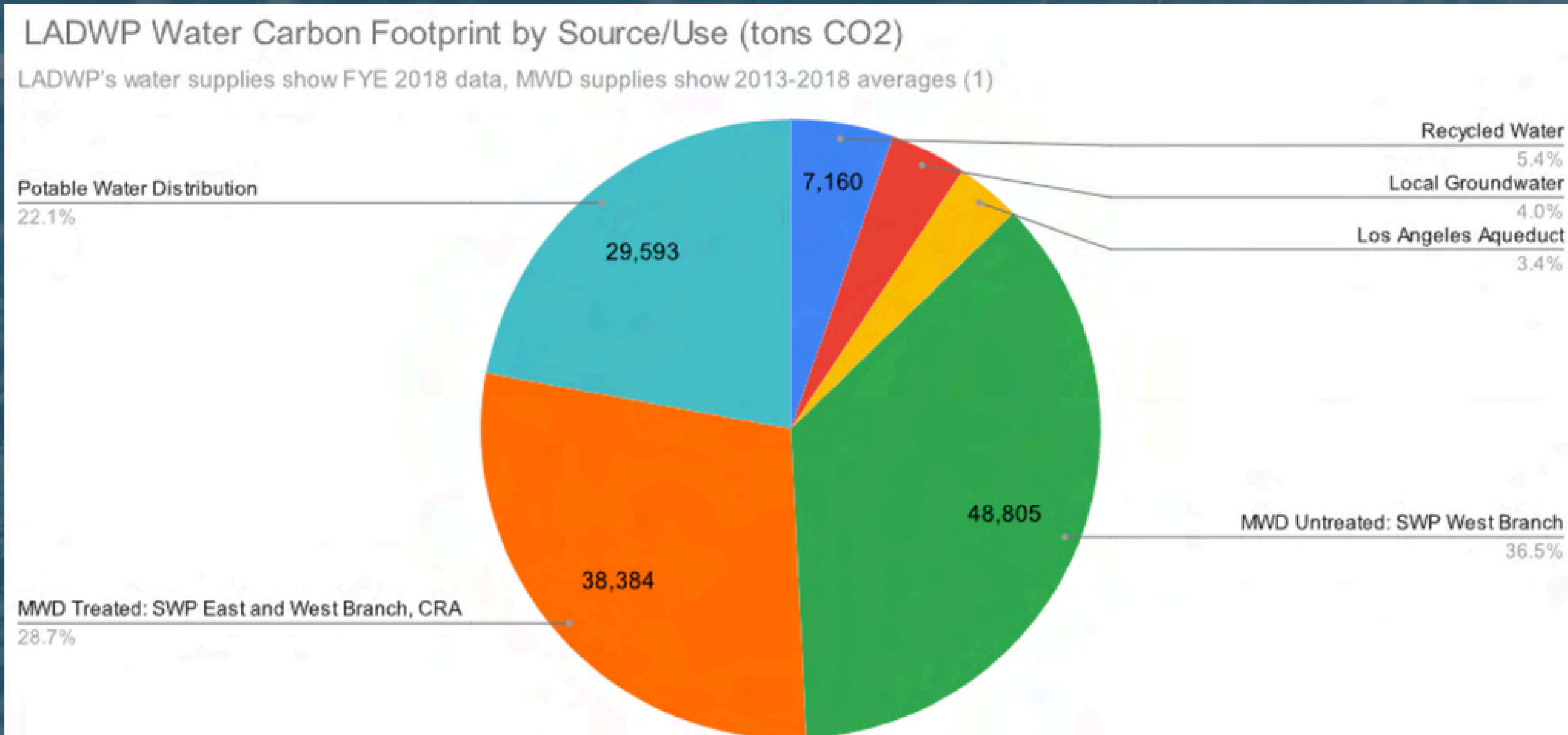
This increase in efficiency is driven by the expanding use of alternative local water sources such as brackish desalination, potable recycled water, and captured stormwater instead of energy-intensive water imports. In addition, water conservation and efficiency improvements in indoor residential water use (the most energy-intensive sector) could decrease water-related electricity use by 19%, natural gas use by 16%, and GHG emissions by 41% between 2015 and 2035. Water conservation improvements would help reduce the overall energy intensity of residential water end-use by reducing the volume of water that would need to be heated. However, it should be noted that water conservation measures would not necessarily result in a one-to-one reduction in regional water supply operations.

Translating Energy Costs to Carbon Costs at the Regional Level

Understanding the energy costs associated with our water supply is a critical step toward achieving sustainability. However, it's equally important to translate these energy costs into their environmental counterpart: carbon costs. In this section, we examine the carbon footprint of Los Angeles' water supply, shedding light on the environmental impact of our water sources and distribution.

To calculate the carbon footprint of our water supply, we first consider the estimated energy intensity, which averages 883 kWh/AF of water in LADWP's entire system (1). LADWP calculates the carbon emissions by applying the specific water supply emissions intensity to the appropriate carbon emission factor. The approximate total carbon emissions amounted to 133,829 tons of CO2 in 2018 (1). This staggering figure underscores the energy impact of our water supply system. To find this value, we used different emissions factors for the city’s water facilities compared to imported water. We have employed historical LADWP power generation CO2 emission factors for energy used at the city's water facilities. For imported water from the MWD, we have used eGRID 2016 and 2018 CAMX area values to account for the embedded energy within this water. This approach ensures that we consider not only the energy consumed within our jurisdiction but also the broader energy implications associated with imported water sources.

Translating Energy Costs to Carbon Costs at the Regional Level



The resulting analysis paints a comprehensive picture of the carbon costs of our water supply, considering both local and imported sources. This understanding is crucial as we strive to reduce our carbon footprint and move towards a more sustainable and environmentally responsible water supply system.

Desalination Discussion

As Los Angeles is a coastal city, any discussion of large-scale water savings will inevitably bring up the proposal of seawater desalination. In this section, it will be important to condition any claims of higher water savings on the various energy and environment-related cons involved with such programs. Industrial support for desalination programs has recently increased—in 2022, the South Coast Water District secured $32 million in federal and state grants for their project in Dana Point, allowing construction to move forward. The plant would produce 5 million gallons per day, exceeding the 2 million that the district needs to function on a daily basis (4). Extra water would be distributed to a greater area that normally needs to import their water from afar.

The approval of this project is in the wake of the rejection of similar plans in Huntington Beach, citing cost concerns and issues with habitat protection. Traditionally, desalination has been considered a threat to ocean biodiversity, as the process has historically impacted undersea organisms, whether displacing them alongside the salt in the water or dumping salty and disruptive wastewater into volatile habitats (5). While technological innovation may help address some of these concerns, desalination currently contains energy concerns. A report from the U.S. Department of Energy states that running high-powered pumps to complete the reverse-osmosis processes of separating salt from water can make up 25-40% of the energy cost of water alone (7). With that said, emerging technologies and methods of placing water intake in non-harmful locations are being researched by leading institutions[3] due to the importance of the policy's potential (8). There is room to be optimistic about its future, but the dangers of seawater desalination technology give us a sobering reminder of the non-monetary drawbacks of maximizing water efficiency in a drought-ridden climate.

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3 Reverse-osmosis requires pushing water through a semipermeable membrane that separates out salts. According to the report, the process can demand as much as 800-1000 pounds per square inch (psi) multiplied by the incoming flow rate of the water.

Externalities Associated with Water Lifecycle

In this section, we qualitatively discuss the externalities associated with the lifecycle and long-term impacts of water extraction, processing, distribution, use, and disposal. These do not particularly point to immediate action plans.

However, it is critical to be aware of and understand the holistic implications and hidden costs of using water as an individual or business. We resume the discussion on the energy costs of water in section 2.

Source: Maven's Photoblog

Externalities Associated with Water Lifecycle

Aquifer Depletion

- **Primarily caused by:** changes in precipitation patterns, excessive groundwater withdrawal, impervious paved surfaces
- Once depleted, aquifers can take millennia to replenish (9).
- Severe consequences on food production, access to freshwater, and the well-being of up to 1.8 billion people in India, Pakistan, southern Europe, and the United States by mid-century (10).

Biodiversity Loss

- **Habitat change and loss:** reduces species abundance, genetic diversity, richness, and distribution
- Regions with high habitat loss are more likely to experience declining population rates
- This disturbs specialist species, trophic chains, interactions, dispersal, breeding success, predation, and foraging rates (11).

Proliferation of Pests

- **Stagnant water - ideal breeding ground for pests** such as mosquitoes and roaches which can carry diseases such as West Nile and Zika viruses (12)
- Recent record rainfall led to a local surge in mosquitoes, gnats, bees, and midges.
- With continued snowmelt, the mosquito season is expected to be extended (13)

Land Degradation

- **Caused by factors such as:** extreme weather, over-extraction of water, pollution, and human activities, harms soil quality, impacts food production, livelihoods, and ecosystem services
- Over-cultivation, overgrazing, deforestation, and urbanization have accelerated land degradation
- Leads to reduced food production, water scarcity, and population displacement (14)

Chemical, Thermal, Nutrient Pollution

- **Coastal waters are polluted by a range of substances including:** petroleum, pesticides, sediments, sewage, agricultural waste, thermal waste from power plants and factories, and chemical waste with radioactive elements
- Human sewage (consisting of toilet waste, bathing, laundry, and food remnants) can lead to nutrient over-enrichment and the spread of disease-causing microbes
- This poses as a threat to ecosystems and public health (15)

Political Tensions

- **Political tensions are rising** among the seven Colorado River states over water rights claims
- California is claiming the largest annual water allotment due to historical use, but states are questioning practicality of original agreement (16)
- U.S. faces water disputes with Mexico due to challenges in meeting water demands, leading to supply jeopardization (17)

Community Displacement

- Hydroelectric mega projects such as dams displace communities
- Around **40-80 million people** were displaced by 245 large dams built from **1934 to 2007**
- Rightful compensation for their land and buildings, resettlement, and disruption of livelihoods is severely lacking (15)
- While hydropower is a renewable energy source, more sustainable and socio-economically sensitive approaches could be explored (18)

Equity and Health Concerns

- Access to clean water varies by race, class, and location, as seen in areas like South and Southeast LA County
- Low-income communities of color face **health disparities** due to contaminated soil and inadequate infrastructure
- Comprehensive policy changes, significant infrastructure investments, and improved water systems are necessary to build trust and ensure water quality for all (19)

Wastewater Considerations

- **Three key wastewater management concerns:** energy consumption, operational costs, and management efficiency
- Wastewater treatment plants, running 24/7, can consume up to 30% of their expenses in energy costs
- Use of chemicals and sewage sludge treatment raises operational costs
- Efficient organization and management are vital for smooth plant operation and to prevent human errors (20)

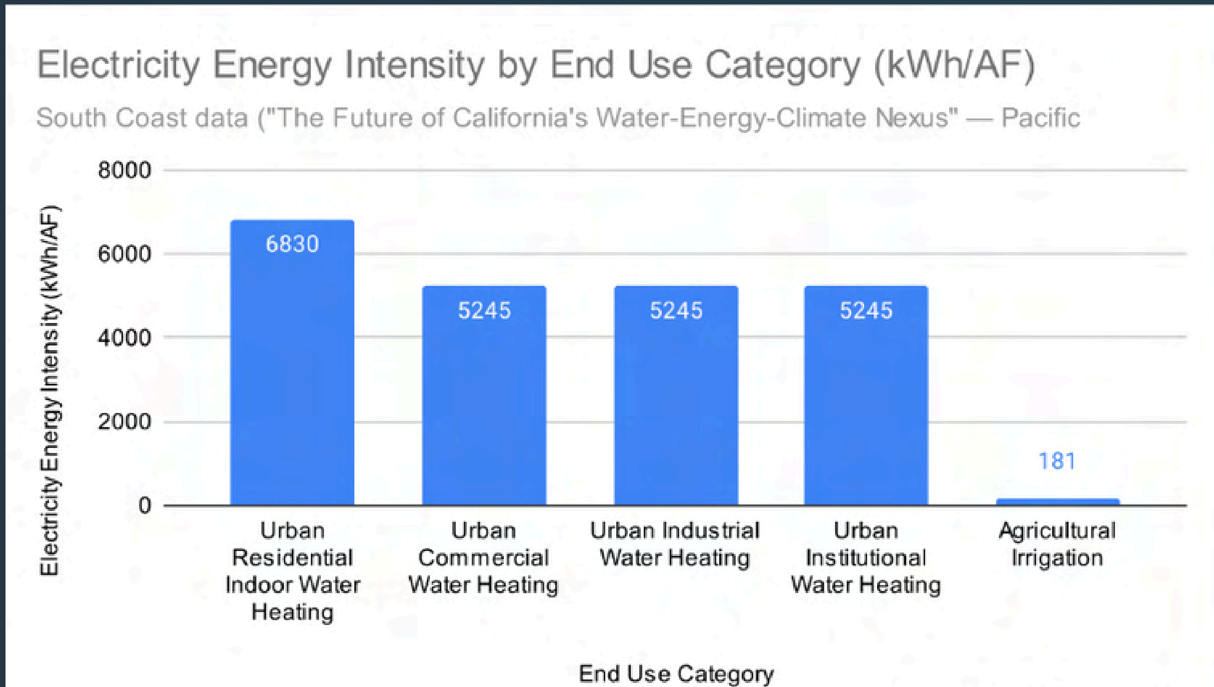
SECTION 2: THE BUILDING

According to the Pacific Institute, water's most energy-intensive part of the value chain is the end use for the South Coast hydrologic region.

Within this segment, the highest energy intensity is found in urban residential indoor water heating.

This section delves into the specifics of energy in water at the end-use, shedding light on opportunities for optimization.

Overview of End Use in the South Coast Region

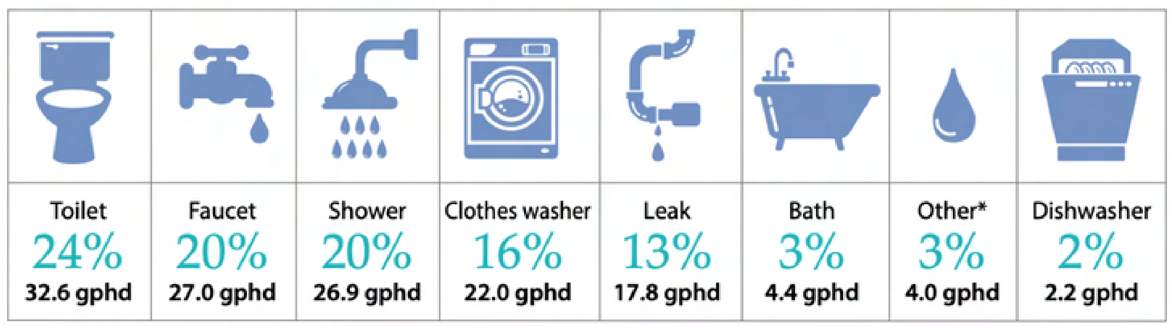


Source: Pacific Institute

Heat constitutes a substantial portion of end-use energy, accounting for 99% of the total energy consumption in the context of water. Residential, institutional, commercial, and industrial heating share the load nearly evenly, emphasizing the widespread need for hot water across diverse sectors. This balanced distribution suggests that improvements in energy efficiency and conservation can have a substantial impact across the board, contributing to a reduction in our overall energy footprint and a building's energy efficiency.

Warm Water Use in Residential Areas

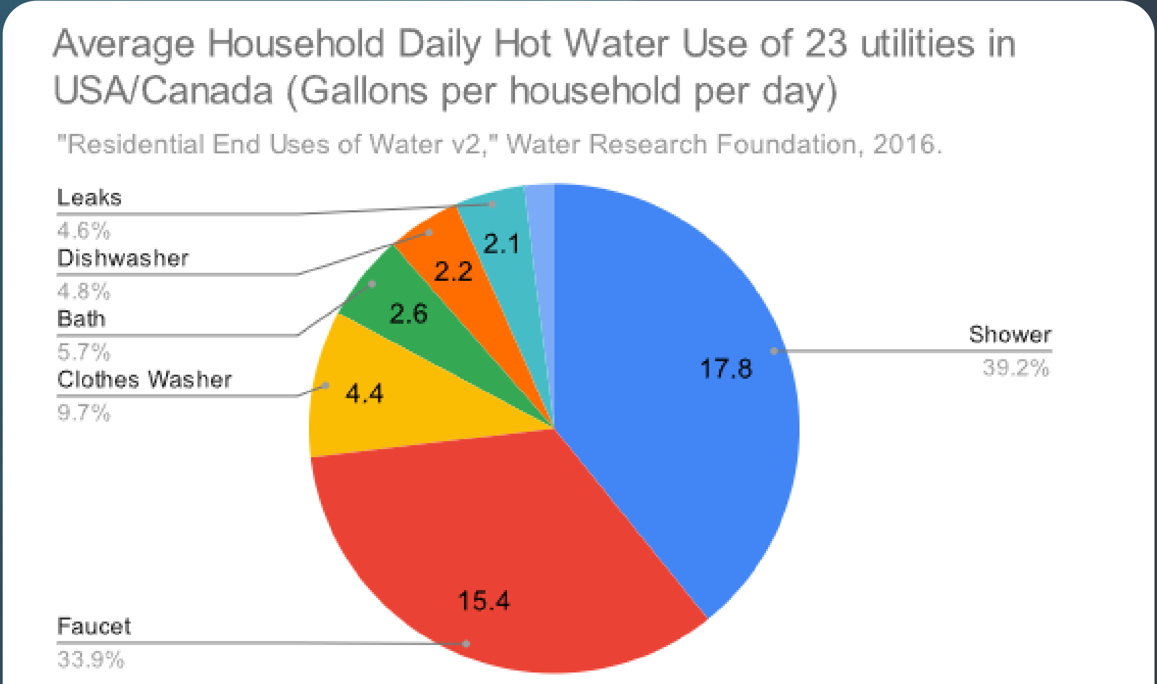
Figure 1. Indoor household use by fixture



* The "Other" category includes evaporative cooling, humidification, water softening, and other uncategorized indoor uses.

Source: Water Research Foundation

Warm Water Use in Residential Areas



Source: Water Research Foundation

Showers and faucets are the primary contributors to residential hot water use, constituting 73.1% of the total daily hot water use per household. Additionally, these two components account for 40% of the overall water use in residences. This emphasizes their central role in the energy-water nexus and highlights the potential for significant energy savings through more efficient use.

Indoor strategies, such as recirculating showers, are the most promising to reduce water-related energy intensity in residences. These strategies focus on conserving, reusing, and recycling heated water, thereby reducing the need to continuously heat large volumes of water and the energy used for wastewater treatment. This approach simultaneously lowers energy consumption and conserves water, aligning with broader sustainability objectives.

Between 1999 and 2016, showers, faucets, and bathtubs showed no decrease in water use based on the WRF study, which is on the national scale. In contrast, other fixtures in homes saw substantial reductions in water use during the same period: clothes washers (36% decrease in average daily gallons per capita), toilets (29% decrease in gallons per flush), dishwashers (39% decrease in gallons per load), and leaks (17% decrease in average daily per capita). This data underscores how integrating water efficiency technology into design has been able to create long-term and widespread water reductions by automating water efficiency and conservation.

Warm Water Use in Residential Areas

However, behavioral-dependent and manually-controlled fixtures (such as showers, faucets, and bathtubs) still need targeted efforts to promote water-efficient behavior despite increased efficiency. Efforts to reduce warm water use in showers and faucets include the installation of high-efficiency fixtures, such as showerheads and faucets with aerators. These can significantly reduce water flow without sacrificing performance. Additionally, raising awareness and promoting water-efficient behaviors, such as shorter and colder showers and turning off faucets when not in use, can substantially impact water and energy savings.

The Pacific Institute estimates that if urban per-capita water demand is maintained at 2015 levels, statewide urban water demand is projected to increase 24 percent (1.3 million AF) between 2015 and 2035. With the compounding impacts of demographic and climate change, the City of Los Angeles urgently needs to address water conservation and efficiency measures in the residential sector to sustainably meet the rising demand for water and energy.

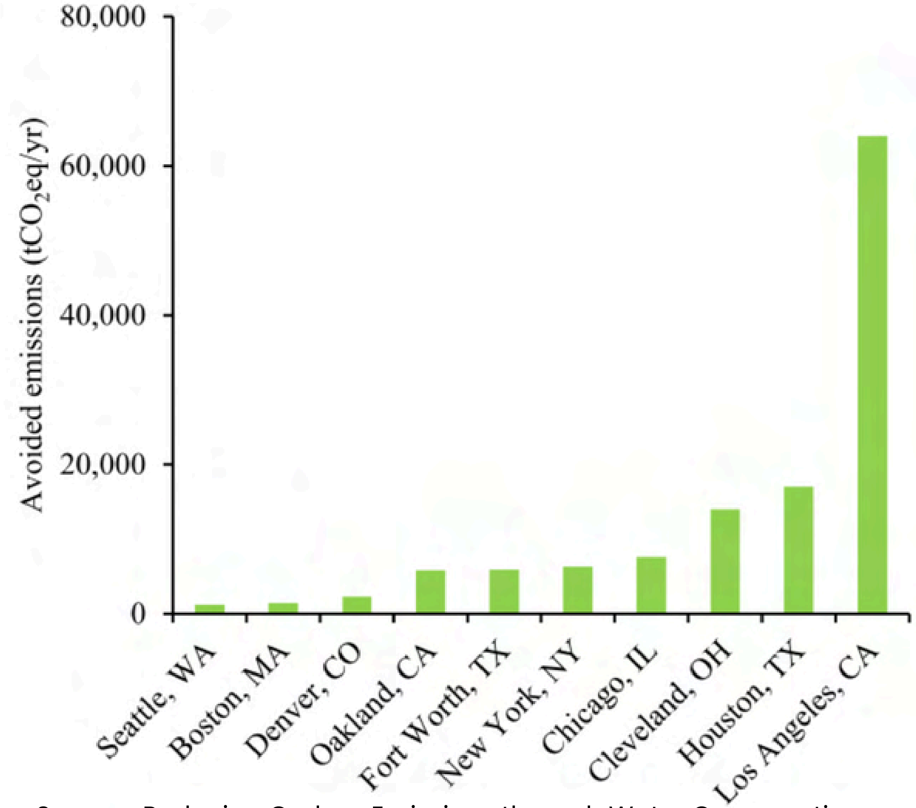
SECTION 3: BEST PRACTICES

Source: Water and Power

Water conservation is no longer simply a matter of savings on utility bills (for both water consumption and energy use for water heating) —firms and organizations that find ways to use water efficiently are also making strides towards their greenhouse gas emissions and water security goals. A 2022 study combined data for the energy required to deliver a unit of potable water to its destination with the associated CO_2 emissions of that energy for ten major US cities (22). After calculating water-related emissions, they calculated avoided emissions if all ten cities decreased their water usage by 10%. The results, from the perspective of an LA resident, are striking.

SECTION 3: BEST PRACTICES

As seen in **Figure 4, over 60,000 tons of CO2 would be avoided by just a 10% reduction in water use in Los Angeles**, which is **more than three times** the savings of the next-largest city.



Source: Reducing Carbon Emissions through Water Conservation

Fig. 4. Potential emissions avoided through 10% water conservation.

These numbers indicate that, as a business owner, landlord, or even household, our attempts at reducing our water can meaningfully reduce our carbon emissions. This means that upgrades such as high-efficiency faucets and stormwater recycling, when coupled with renewable energy systems, can be added to annual emissions reports and provide a head start on avoiding looming climate change-era policies such as carbon taxes, increased water prices and more stringent water use requirements. These changes will also save money directly, whether through government-subsidized rebates or reduced water and energy bills. **This section outlines best practices for reporting such water-related efforts on carbon footprint portfolios.**

Households

Quantifying consumer-level water use is important due to its capacity for major cuts under the right guidance. According to a 2005 report by River Network, the **end-use stage of the water use cycle has the highest potential for savings in both water and energy**—and thus carbon emissions (23).

Source and conveyance ▷ Treatment ▷ Distribution ▷ End use ▷ Wastewater treatment

Much of this category involves the additional heating and cooling of water for various cleaning and HVAC purposes. The 2005 study found that if all US households installed efficient fixtures and appliances, 4.4 billion gallons of residential hot water use would be decreased annually (this is not to mention how much more efficient modern fixtures have become). This would translate to nearly **40 million tons of CO2 emissions reduced** per year (pg 36).

Using tools such as the **EPA's WaterSense <u>calculator</u>** to construct a household's carbon footprint portfolio, residents can take the necessary steps to add water considerations to their emissions (24). Water suppliers such as the LADWP significantly incentivize reductions in water use at home through implementing high-efficiency fixtures.

Commercial, Industrial, and Institutional (CII) Sector

Households are not the only consideration for accurate LA County carbon accounting; the River Network reported that the commercial, industrial, and institutional (CII) sector was part of nearly 40 million gallons per day of usage, with potential savings as high as 50%. In some cases, a similar philosophy can be applied to households—improved appliances such as pre-rinse spray valves installed in California restaurants saved 50,000 gallons annually and 7,600 kWh of gas-powered energy (pg 28). However, with increased institutional

Stormwater capture is an actionable step that landlords, businesses, and even residents can use to combat the rise of entrants into cities, and thus pollution, from recent population trends. Between 770,000 and 3.9 million acre-feet of water spill away through stormwater drains in CA per year (25). With the recent wet season, including Hurricane Hilary, these numbers could increase, putting emphasis and significant value on this particular solution. Fortunately, plenty of rebates from utilities such as the Metropolitan Water District and LADWP allow the installation of water-capturing barrels and cisterns for cheap (26).

Aside from rebates, co-benefits associated with stormwater capture should offset other costs—a 2020 economic analysis found that, when incorporating co-benefits such as decreased energy use and increased property values, the expected cost of water managed from stormwater capture projects was reduced from $1,030 to $150, with some even providing a net benefit (27). Households can also leverage these savings opportunities similarly to businesses in the CII sectors.

Industry Leaders

Looking to industry leaders in water use reduction is perhaps the best way to visualize best practices. One such success story is the Westin Los Angeles Airport Hotel, which **cut its energy use by a quarter** in 2014 with help from LADWP incentives. The rebates specifically targeted new high-efficiency water chillers alongside a water-side economizer, which can reduce the costs of a chilled water

plant by up to 70%.[4] The savings attributed to their central plant highlight the potential for increased water efficiency even in the high-end commercial sector—these rebates are not simply for small-scale residential projects. Resource stewardship and profit growth are not mutually exclusive. The Westin Los Angeles Airport Hotel leveraged efficiency improvements, such as reducing the gallons used per toilet flush by 20% for 740 toilets. Through these efforts and more, the hotel saved over **$200,000** a year in energy costs and received **$339,597** in rebates.[5]

Source: LADWP

Water savings need not always be for interior building use. Anthem Blue Cross took a look outside their offices to remove 554,000 square feet of turf, nearly ten football fields' worth of grass. **Replacing grass with artificial turf or native drought-resistant shrubs** can be a great way for homeowners and businesses alike to decrease their water footprint—the conversion to native, drought-tolerant trees and shrubs saves them nearly **$85,000 annually** in water bills and landscaping costs and also benefited from a rebate incentive of over **$1.1 million** from the LADWP. Most of these water savings come packaged with reduced energy use from the comparative lack of water that drought-tolerant shrubs need—as has been repeated throughout this paper, sometimes the best way to conserve energy is by conserving water. Anthem Blue Cross was able to complete their project in a speedy five months, but keep in mind that a typical landscaping project with California native plants can take up to 1-2 years to fully complete.

4 Water-side economizer uses evaporative cooling to produce chilled water in winter instead of the chiller. Learn more through EnergyStar's website.

5 The LADWP is currently providing $300/toilet for eligible toilets to incentivize toilet replacements. See more case studies through the LADWP website.

SECTION 4: CONCLUSION

In the first section of the paper, we explored **the regional-level energy costs associated with the conveyance, treatment, and distribution of the City's water**. This revealed a notable reliance on imported water to meet local supplies, particularly from the MWD. The LAA, which supplies 59% of the City's water, emerged as the least energy-intensive water source (191 kWh/AF), while imported water from the MWD and recycled water contained higher energy intensities (~2000 kWh). Furthermore, a regional comparison highlights that Los Angeles faces greater energy intensity challenges in its water system compared to other areas in California. However, a positive outlook is that Los Angeles expects a 2% reduction in urban water system energy intensity by 2035, driven by the adoption of alternative local water sources and water conservation measures.

An estimated **133,829 tons of CO2 emissions** were associated with Los Angeles' water supply in 2018. The majority of this consists of emissions in the SWP and imported water. We also shed light on the nine externalities associated with the conservation measures. An estimated **133,829 tons of CO2 emissions** were associated with Los Angeles' water supply in 2018. The majority of this consists of emissions in the SWP and imported water. We also shed light on the nine externalities associated with the lifecycle of the water: aquifer depletion, biodiversity loss, proliferation of pests, pollution (chemical, thermal, and nutrient), political tensions, community displacement, equity and health concerns, and wastewater considerations.

SECTION 4: CONCLUSION

In the second section of the paper, we took a deeper dive into **water-related energy costs at the household level.** The most energy-intensive part of the water value chain is the heating for end use, with urban residential indoor water heating being a primary contributor. Heat, accounting for **99%** of the total energy consumption in water end use, is almost equally balanced across residential, institutional, commercial, and industrial sectors. Focusing on residential water use, we found that showers and faucets constituted **72.9%** of daily household hot water use and **40%** of overall household water use. This emphasizes the joint need for integrating higher efficiency fixtures as well as behavioral usage conservation. The urgency of these measures is underscored by projections indicating a **24% increase** in statewide urban water demand between 2015 and 2035.

The final section of this paper outlined the rebates and best practices applicable to homeowners, landlords, and business owners looking to save water and energy. Implementing HVAC upgrades, stormwater capture, and low-flow plumbing into one's building can not only translate to savings on current water and energy bills but also decrease overall carbon footprints across the county. As mentioned above, even just a 10% decrease in water usage decreases carbon emissions by over 60,000 tons of carbon dioxide annually. The takeaway of this section—and the paper as a whole—is that sizeable energy use and carbon emissions are caused throughout the lifecycle of water. Thus, all residents of Los Angeles have the agency to make *real* impacts on drought and climate change alike through optimizing residential and commercial water use.

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Energy Cost of Water

Exploring the embedded energy and carbon costs of water for the Greater Los Angeles Region.

Contact us | info@usgbc-ca.org