Every drop counts: Water strategies for refiners

The macro-level drivers of water scarcity are discussed along with typical process facility uses, providing insights on factors in a successful water management strategy

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A panel of industry experts at the AFPM 2026 Annual Meeting addressed challenges posed by water shortages, offering collective insights from operational experience, engineering practice, regulatory oversight, and sustainability research.

Despite being a critical component of petroleum refining and petrochemical operations, water has long been treated as an abundant and inexpensive utility; a resource that flows reliably from municipal systems, lakes, rivers, or local aquifers and is consumed in processes such as evaporative cooling, steam generation, wash water, or for fire protection. That era is ending.

Competition for fresh water due to drought patterns, population and economic growth, and growing industry represents a risk to refinery production rates. An effective water use and conservation strategy is critical to refinery operations. Veolia North America's Triple Net Zero Study noted that, as of 2024, 71% of companies surveyed had already implemented some form of water efficiency or conservation programme,[1] with opportunities to strengthen these strategies and plans.

What follows is a structured guide to the challenge and potential strategies that refiners and petrochemical producers can utilise to secure long-term fresh water supplies and optimise their water usage without impacting production or operational efficiency.

Limited availability vs increasing demand

Only 1% of all fresh water is accessible for human use.[4] This limited supply supports agriculture, municipal consumption, industrial production, and ecosystem health for a global population that continues to grow. According to the World Economic Forum, reported by CNN in 2026, global water demand is projected to exceed supply by 40% by 2030.[2,3] In some regions, shortage of usable freshwater is not a distant, theoretical scenario; it is happening now.

When US refinery, petrochemical, and natural gas processing locations[5] are overlaid on historical drought maps,[6] vulnerability to drought becomes unmistakable. As shown in **Figures 1a** and **1b**, significant concentrations of petroleum refining and petrochemical capacity sit in Texas, the Gulf Coast, California, and the broader Southwest, precisely the regions that have experienced the most severe and sustained drought conditions over the past decade.

In today's world, water risk management must be treated as a dynamic, ongoing discipline rather than a one-time assessment.

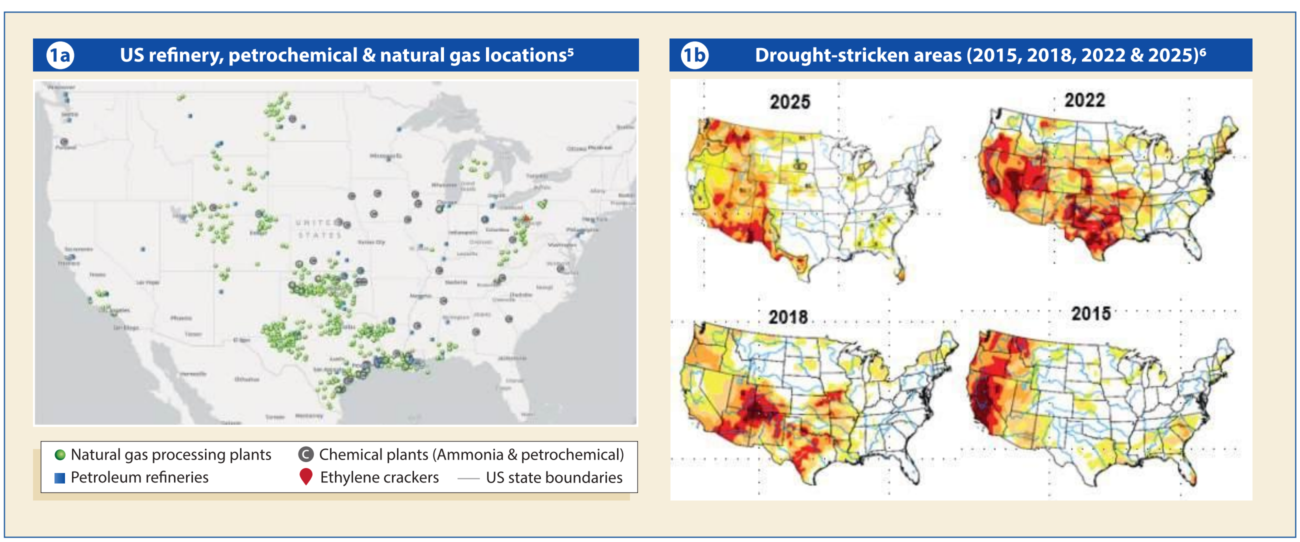

Figure 1 US oil and gas locations vs water scarcity[5,6]

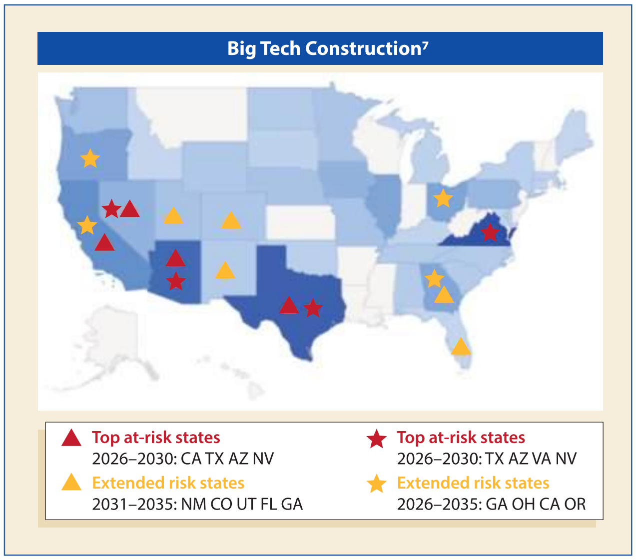

Figure 2 Big tech new construction growth intensity map, overlaying water consumption at-risk states due to broad regional growth (population, agriculture, urban use), shown as red and yellow triangles, and data centre and chip manufacturing expansion, shown as red and yellow stars[7]

New competitor for water: The digital economy

Compounding the challenge for refiners and petrochemical producers is the explosive growth of a new class of industrial water consumer: data centres. A large amount of evaporative cooling is required to keep servers in these data centres from overheating, and water is used to generate the enormous amounts of electricity required to operate these facilities.

Driven by the insatiable demand for artificial intelligence (AI) computing power, US data centre water use is projected to quadruple to between 68 billion and 280 billion gallons annually by 2028-2030.[8] These facilities are being constructed on a scale in many of the same drought-prone states where refineries already operate and are under water stress. This creates new and intensifying competition for freshwater. Refiners that have historically relied on established water rights or municipal supply agreements may find those arrangements challenged as data centres, chip manufacturers, and growing urban populations all compete for the same diminishing water supplies.

Figure 2 illustrates the bespoke situation,[7] depicting how data centres and chip manufacturers significantly amplify water consumption risks in drought-prone states (statista.com). States in the Southwest and Southern Plains face the highest risks (see 'top at-risk states' and 'extended risk states') to water consumption from drought over the next five to 10 years, driven by high per-capita use, agriculture, and urban use (as reported by ABC News 2026 and theboxhouston.com 2026).

Data centres and chip manufacturers significantly amplify water consumption risks in drought-prone states (Figure 2). Projections show US data centre water use could potentially quadruple to 68-280 billion gallons annually by 2028-2030 due to AI-driven cooling and power needs.[8]

Building a water strategy that lasts

Lasting and sustainable water use improvement comes from developing and maintaining a well-designed, carefully planned water use strategy. As part of this strategy, initiatives and actions need to be prioritised. The strategy should start by understanding and accurately sizing a facility's water footprint, before proceeding to optimise recovery and reuse, and finally considering major investments.

As shown in **Figure 3**, one way to look at a water strategy structure is to compare it to harvesting fruit from an apple tree. The priority, or the 'low hanging fruit', consists of operational fundamentals: establishing or improving procedures, maintenance, controls, and consistent execution of these controls. These actions or changes are usually low-cost but produce fast results. More importantly, they establish credibility and create the baseline needed to evaluate larger opportunities with confidence.

Understanding refinery water use

The first step in developing an effective and sustainable water strategy is understanding the source(s) and quality of the water consumed, and the purposes for which the water is used in the refinery. If one does not understand where and how their water is being used, the actions and justification to implement these actions cannot be determined. This starts with developing a detailed water balance.

Figure 4 is a general overview of a typical refinery's water sources, uses, and consumption.[9] As shown, water can originate from a variety of sources, including groundwater, surface water, purchased from a municipality, or even recycled wastewater. While every refinery has its own unique arrangement and combination of refining processes, consumption in the refinery can be categorised as continuous or transient operations.

When evaluating the water balance, it is important to distinguish between water that can be recovered

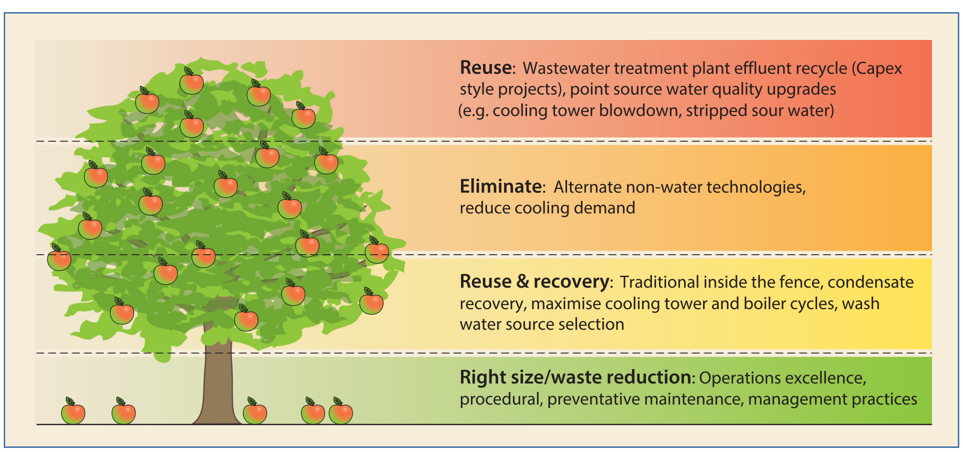

Figure 3 Water strategy priority strategy: reduction, recovery, eliminate, and reuse

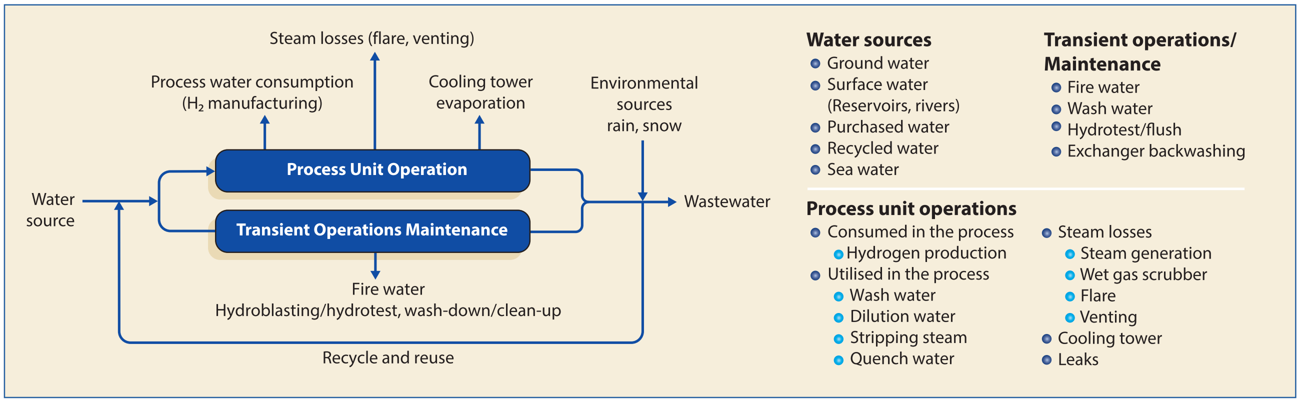

Figure 4 General overview of refineries' water sources, uses, and consumption[9]

or utilised/recycled for other purposes and that which is unrecoverable.

Figure 5 is a summary of the water consumption of a typical refinery. As shown, much of the water consumed in the refinery (50-60%) is used for evaporative cooling and wet gas scrubbers, where most of the water is lost to evaporation.[9] While these applications typically have a recycled water flow, which includes a purge or blowdown of the circulating water, much of the evaporated water cannot be reused or treated to be reused in another process. Some reduction in water use can be accomplished by improving make-up water quality (fewer salts) or by 'cycling up'. However, the trade-off is that fouling or corrosion can increase.

Typically, inside the fence, water reuse opportunities include steam condensate recovery for boiler feedwater or wash water. Due to water's general abundance and low cost, water reduction projects can be difficult to justify, a theme sometimes mirrored in wastewater reuse, as this often requires treatment upgrades, making it economically difficult to pursue. A clear understanding of the future water supply risk to operations is needed, which may include:

- **Regulatory requirements**: While US federal regulations focus on safe drinking water quality and wastewater discharge quality, some state and local municipalities, driven by droughts or increasing water demand, are increasingly imposing restrictions on groundwater withdrawal and surface water use. Refiners affected by these restrictions need to determine whether they are temporary or permanent, as well as assess the volume and quality of available water.
- **Cost**: The cost of purchasing water from a third party, such as a municipality, or the cost of treatment to improve the quality of the make-up water, may be enough to justify investments in additional water treatment or the use of alternative water sources.
- **Equipment limitations**: Poor water quality driven by the need to operate at higher cooling water or boiler cycles may result in decreased efficiency or reliability of equipment due to increased corrosion or fouling.
- **Restricting refinery production**: Lack of water or volume or quality, such as the lack of cooling water, can restrict the throughput or product slate of the refinery.

Water use audit

Once a refinery's water usage and drivers are identified, the next step in developing a water use strategy is to conduct a comprehensive water use audit. A proper water use audit should be led by experienced personnel with site credibility and include:

- **Quantify all water uses and losses**: This is the previously mentioned water balance.
- **Distinguish between recoverable and unrecoverable water**: Unrecoverable water is normal due to evaporative losses. These losses are driven by heat removal requirements; can these requirements be reduced, or can alternative methods of cooling be used instead?
- **Evaluate water quality and reuse potential**: Can the

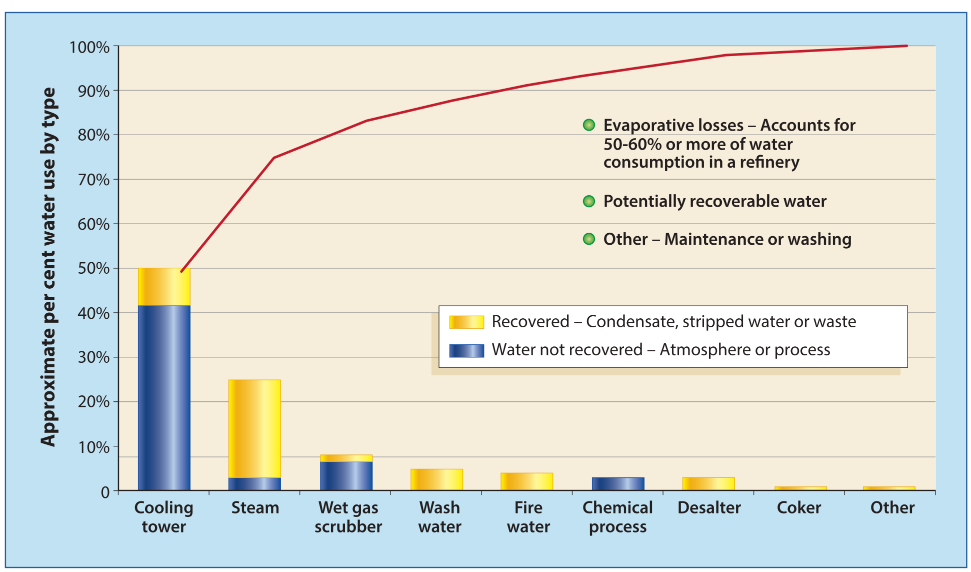

Figure 5 Typical refinery water volume use by type (recovered or not recovered)[9]