





Minimizing environmental impact

We aspire to create a legacy of projects that improve natural habitats and protect shared resources, through best practice environmental management systems and initiatives that promote positive outcomes.

We apply technology, innovation, and resources to invest in environmental protection and nature-based solutions, and we embed circular economy principles across our operations.

Material topics

Relevant metrics

Relevant UN SDGs

Local environmental impact

Number of hydrocarbon spills
Volume of hydrocarbon spills (bbl)
Recovered hydrocarbon* (%)
Hydrocarbon discharge to water (barrels)
SO₂ emissions (kilotonnes)
Number of sites with ISO 14001 certification* (%)



Biodiversity and ecosystems

Net positive impact*



Water management

Freshwater consumption (million m³)
Freshwater withdrawal (million m³)



Product stewardship and waste management

Industrial waste generated (metric tonnes)
Industrial waste recycled* (%)



* Metric reported for the first time externally.

For more details on relevant metrics, see page 86.



Scan here

Learn more about how Aramco is taking real steps to protect the environment, and engaging in a range of projects and initiatives.

Local environmental impact

Environmental management systems

Since 2012, our operations have been supported by a strong environmental management system based on ISO 14001 standards. As we strive to be consistent with local environmental regulations while following international best practices, our environmental management system provides a systematic and planned approach to achieve the desired outcomes.

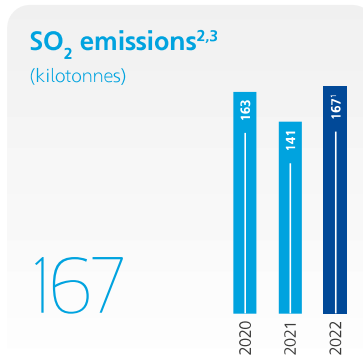
To support the certification process we appointed an independent third party to assess our systems against the requirements of the standard. During 2022, we achieved ISO 14001 certification* for 98%¹ of facilities under our operational control. In 2023, we will continue to progress our efforts to achieve 100% certification.

We also conducted more than 30 environment and health site assessments during 2022 to minimize any negative environmental and safety impact of our operations.

Corporate circular economy roll-out program

In 2021, we commenced the roll-out of a corporate execution plan to apply the principles of circular economy across the Company value chain. We are embedding circularity models in activities ranging from circular material management to environmental performance management to our investment master plan. To date, we have launched over 20 initiatives, in critical areas such as water conservation, waste management, circular procurement services, circular construction and built infrastructure.

We are developing our first integrated waste management facility that aims to deploy waste management technologies to recover, treat and manage the waste generated by our communities and operations. This includes a planned waste-to-energy plant, so that Aramco's waste can become a potentially usable source of energy for the Company. Please see page 67 for more details on our waste management initiatives.



SO₂, NO_x, and VOCs

We continued the development of the Sulfur Recovery Units Dashboard, which monitors all Aramco sulfur recovery units (SRUs) to ensure safe and optimal operations. The real-time dashboard shows key SRU performance tracking parameters that are used to ensure the highest possible overall sulfur recovery efficiencies. We also continued our SRU upgrades with tail gas treatment units to reduce SO₂ emissions. We are expediting these projects in line with our commitment to environmental stewardship and to support our efforts in fulfilling our compliance obligations. Tail gas treatment is gaining importance as the preferred technology to address stipulations on sulfur recovery systems in the latest revision of environmental regulations in the Kingdom and as we explore economic opportunities for sulfur itself. We are focused on ensuring these technical improvements are implemented at scale to achieve their full potential.

In 2022, our SO₂ emissions were 18% higher than in 2021 due to increased production of gas from our facilities. As we continue to scale up our operations, technologies like SRU tail gas treatment will support our efforts in keeping our SO₂ emissions low relative to our production.

During 2022, we achieved ISO 14001 certification* for

98%¹

of facilities under our operational control

* Metric reported for the first time externally.

1. This figure has undergone external limited assurance in accordance to the ISAE 3000 (revised). The assurance report can be found [online here](#).

2. For this metric, the reporting boundary has been reclassified from operational control excluding ATC, ASC, AOC and SAAC to operational control for 2022, 2021 and 2020. This is because ATC, ASC, AOC and SAAC are office-based entities and therefore, have no SO₂ emissions

3. The Jazan Refinery (our downstream refinery) is excluded from our SO₂ emissions reporting. In 2022, it remains in the startup and stabilization phase and is not fully operational. Aramco is working to stabilize the refinery's operations and complete all necessary reporting configurations before the end of 2023. Reporting on the refinery's environmental and sustainability elements will commence immediately thereafter, in line with the company's commitment to operational transparency.

We are working to quantify NOx emissions from our point sources and ensure they follow corporate and governmental mandates. We have improved our relative accuracy testing from every two years to every quarter on all applicable facilities. Increased frequency of testing will allow us to identify the NOx emissions from all applicable operating facilities and address exceedances, if any.

Our vapor recovery system helps to minimize emissions of volatile organic compounds (VOCs) from our bulk loading operations, including new and established refined product distribution depots, which continue to operate efficiently to reduce VOCs from the ambient environment.

Spills to the environment

Aramco operates across Saudi Arabia with many operations in remote areas. This increases the complexity of detecting spills onshore and offshore and providing a swift response to spill sites. We mitigate these challenges by employing rigorous inspection programs of assets, putting fail-safe measures in place, training employees, and utilizing advanced technologies to predict possible failures.

While Aramco strives to achieve zero spills, we encourage the reporting to provide lessons learned and prevent future incidents. Regrettably there were 15 hydrocarbon spills that occurred in 2022 with a total hydrocarbon volume of 142,885¹ barrels. Two major onshore oil spills were responsible for more than 99% of the total oil spills. A volume of 130,000 barrels was spilled due to a ruptured pipe in the pipeline corridor near Shedgum in Saudi Arabia, due to nearby heavy equipment-related work. Aramco managed to rehabilitate the affected area. Further clean-up operations continued at year-end. A volume of more than 11,900 barrels was also spilled due to equipment failure that led to a flow line rupture in the 'Uthmaniyah area; however, the spread of the spill was halted quickly by the response team by isolating the damaged section of the pipe and the team was able to recover the liquid in full. Remediation activities were ongoing at year-end to rehabilitate the affected area.

	2022	2021	2020
Number of hydrocarbon spills	15	13	6
Volume of hydrocarbon spills (barrels)	142,885 ¹	14,447	134



We continuously invest in efforts to ensure lessons are learned from any hydrocarbon spills and shared across our business. In 2022, we improved our asset integrity, process safety and prevention measures through the Company's engagement with regional, national and international entities to carry out oil spill drills to evaluate our response capabilities.

In the event of any spills and resultant pollution, we have response plans that enable rapid mitigation. Our management processes are particularly aligned to minimize the impacts of hazardous chemicals and air, water, and soil pollution and contamination.

We have completed an upgrade on our containment and recovery equipment to ensure we have access to flexible solutions and the latest technology. Currently, we are engaged in efforts to introduce major upgrades to our existing aerial dispersant spray systems with the acquisition of advanced large aircraft.

1. This figure has undergone external limited assurance in accordance to the ISAE 3000 (revised). The assurance report can be found [online here](#).

Biodiversity and ecosystems

Governance framework

With the planet experiencing a dangerous decline in nature as a result of human activity, the United Nations Biodiversity Conference (COP 15) concluded in Montreal, Canada, in December 2022 with 196 countries, including Saudi Arabia, signing up to the Kunming-Montreal Global Biodiversity Framework (GBF). The GBF aims to address biodiversity loss, restore ecosystems and protect indigenous rights, providing a refreshed roadmap for delivering the Global Goal for Nature.

One of the key levers of the GBF is the protection and restoration of ecosystems to deliver 30 by 30 i.e. 30% of land and sea protected and 30% of degraded ecosystems restored by 2030. This principle lies at the center of Aramco's Corporate Biodiversity Protection Policy and standard operating procedures developed in 2021 and applied as governance in 2022. These provide the framework and responsibilities of relevant Company organizations to ensure protection of biodiversity and ecosystem services wherever the Company operates and to restore degraded areas.

The Company continues to work to update its operating procedures and standards to ensure we meet the commitments of the Biodiversity Protection Policy and support the aims of the GBF. We have continued to invest in biodiversity and in 2022 established a dedicated biodiversity team by forming our Environmental Biodiversity Division.

Under the governance framework, Aramco strives to achieve a net positive impact on biodiversity and ecosystem services. In all our new projects we implement the biodiversity mitigation hierarchy, with enhanced outcome requirements for new projects to deliver net positive impacts for biodiversity and ecosystem services. In 2022, we developed a biodiversity KPI to help track the Company's biodiversity performance.

What are we doing?

Achieving a net positive impact¹

Aramco's Biodiversity Protection Corporate Policy provides the road map for all the Company's operational areas to achieve a Net Positive Impact for biodiversity and ecosystem services.

During the year, Aramco developed a new metric to measure and monitor its biodiversity footprint. The NPI is a metric that seeks to achieve net gains for biodiversity and ecosystem services. This occurs when the biodiversity gains through our conservation projects outweigh the overall negative impacts on biodiversity as a result of our operations on our owned land.

In 2022 (our baseline), our NPI* was 53%² and we have set a target to increase the NPI by 30% by 2025.

The KPI is based on spatial area of operational footprint versus the area of biodiversity projects, and so does not include aspects such as ecological quality and condition data. However, it represents the best proxy evaluation of Company's biodiversity currently available. The biodiversity KPI is being further developed to reflect the complexity of biodiversity measurement and assessment.

The most effective way to conserve biodiversity is to avoid operating in high-quality habitat. Where Company activities must interact with biodiversity, we seek to minimize negative impacts by refining our standard operating procedures. When habitats have been impacted, the degraded areas are restored. Finally, unavoidable and long-lasting impacts need to be offset, for example by creating new habitat.

These workstreams are delivered by investing in four enabling elements: a strong governance framework, targeted mapping and monitoring, applied research, and education and awareness. This biodiversity framework aligns with Ipieca guidelines on biodiversity protection and the LEAP (Locate, Evaluate, Assess, Prepare) approach from the Taskforce for Nature-related Financial Disclosures.

* Metric reported for the first time externally.

1. Please refer to page 86 in the Data section of this report for the formula of this metric.

2. This figure has undergone external limited assurance in accordance to the ISAE 3000 (revised). The assurance report can be found [online here](#).

Our biodiversity mitigation hierarchy

Governance framework

Avoid

We avoid high quality habitat

We will not operate in designated world heritage sites, strict nature reserves, or wilderness areas, and will ensure our operations result in no net loss of biodiversity and ecosystems services in national parks, key biodiversity areas and vulnerable bird habitats.



Minimize

We minimize our impacts

During 2022, we designated an additional two Biodiversity Protection Areas; we now have 12 Biodiversity Protection Areas covering 985 km². Together, these sites protect more than 500 species of plants and animals, including at least 55 species or subspecies that are unique to Saudi Arabia.



Restore

We restore degraded habitat

We reintroduced locally extinct species at the Shaybah Wildlife Sanctuary, and restored degraded wetlands at Abqaiq.



Offset

What we cannot avoid, minimize, or restore, we offset

Whenever we have to offset our impacts, we seek to get our offsets assessed by a credible third party.



We map and monitor to understand the biodiversity around us

In 2022, we mapped and monitored the area around us in the Berri Gas Plant identifying various species (see the following page for more details).

We conduct applied research

The Company conducts applied research aimed at ensuring its activities do not cause undue impacts on biodiversity, including collaborative research partnerships with King Fahd University of Petroleum and Minerals and King Abdullah University of Science and Technology.

We invest in biodiversity education and awareness

The Company constructed educational visitor centers at our Mangrove Eco-Park in Rahimah Bay and Shaybah Wildlife Sanctuary in the Rub' al-Khali.

Minimizing environmental impact

Biodiversity at Aramco

An impressive array of biodiversity exists within Saudi Arabia, including over 2,400 plant species, 1,230 marine fish species, 499 bird species, 266 coral species, 117 mammals, 107 reptiles, eight amphibians, eight freshwater fish, and numerous invertebrates. It is inevitable that our activities will at times overlap and potentially impact areas of biodiversity value and much of this biodiversity can be found in our operations and reservation areas.

Our operating areas, including fenced areas, along coastlines and around offshore platforms, are home to significant patches of remnant biodiversity. These provide high quality habitat for threatened, endemic (unique to Arabia), and/or migratory species. By conserving these valuable natural resources, the Company helps to fortify the Kingdom's biodiversity for current and future generation, and replenish terrestrial and marine ecosystems and their ecosystem services, including promoting well-being within our workforce. We coordinate with and contribute to national biodiversity strategies within Saudi Arabia and wherever we operate.

We have created digital habitat models that identify and show the potential habitat of every species that resides in the Kingdom. These habitat models enable Aramco to identify, prioritize, avoid, and reserve high quality habitat on Company land and reduce impacts on biodiversity, as well as targeting resources for restoration and biodiversity protection.

In 2022, at our Berri Gas Plant in northern Saudi Arabia, we conducted a comprehensive biodiversity survey to map species and habitats found within the area of the facility (32 km²). The study identified 431 species; 204 plants, 163 birds, 41 mammals, and 23 reptiles. Of these 45 species were recorded as High Conservation Priority Species, as per the International Union for Conservation of Nature Red List of Threatened Species.

Biodiversity Protection Areas

The Company identifies and designates its own Biodiversity Protection Areas over valuable patches of habitat, which we avoid operating in. An internal procedure outlines the steps required to designate Aramco Biodiversity Protection Areas over high quality habitat, requiring a third-party consultant to confirm that a proposed site is of sufficient ecological quality to warrant designation as a corporate Biodiversity Protection Area.

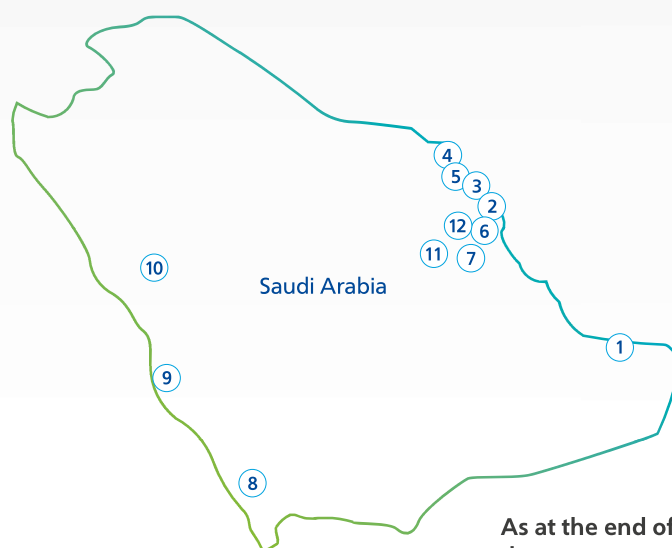
Aramco's Biodiversity Protection Areas

The most effective way to conserve biodiversity is to avoid high-quality habitat. Under the Corporate Biodiversity Protection Policy, Aramco will not operate in designated World Heritage Sites, Strict Nature Reserves, or Wilderness Areas, and will ensure our operations result in no net loss of biodiversity and ecosystem services in National Parks, designated Important Bird and Biodiversity Areas, Important Plant Areas, and Aramco Biodiversity Protection Areas.

Biodiversity Protection Areas contain at least 55 endemic species or subspecies (plants and animals that are found only in the Arabian Peninsula).

Our protected sites:

- | | |
|---|--|
| ① Shaybah Wildlife Sanctuary | ⑧ Abha Biodiversity Protection Area |
| ② Rahimah Bay Mangrove Eco-Park | ⑨ Bahra Biodiversity Protection Area |
| ③ Abu Ali Island | ⑩ Madina Biodiversity Protection Area |
| ④ Tanajib Biodiversity Protection Area | ⑪ Khurais Biodiversity Protection Area |
| ⑤ Manifa Biodiversity Protection Area | ⑫ Bagga Bird Oasis |
| ⑥ Abqaiq Wetlands | |
| ⑦ Udhailiyah Biodiversity Protection Area | |



As at the end of 2022,
there were over
985km²
of Biodiversity
Protected Areas

In 2022, the Company increased its Biodiversity Protection Network by 20%, and currently has twelve designated sites totaling over 985 km². Each of these sites is recognized as fulfilling International Union for Conservation of Nature protected area criteria and protects regionally or internationally significant biodiversity, such as the presence of threatened, migratory and/or endemic species.

Over 500 species of birds, reptiles, mammals, amphibians, and plants are protected within Aramco's Biodiversity Protection Areas, including at least 55 endemic species or subspecies. Many of these species are globally endangered; others are highly migratory, flying 10,000 km or more to forage at Company protected areas; some exist in Arabia and nowhere else on earth — and all of them need our ongoing stewardship.

Wetlands strategy

Water plays a vital role in the ecology and environmental health of the nation. In 2022, a Company-wide wetlands strategy was developed, consisting of two major themes that reflect the intersection of the Company with Saudi Arabia's environment:

- Restoration and protection of natural wetlands on Company land, primarily for biodiversity conservation outcomes (but with co-benefits such as carbon sequestration); and
- Creation of constructed wetlands that provide nature-based solutions for sustainable and efficient wastewater treatment (with biodiversity and other ecosystem service co-benefits).

Fact-finding missions to constructed wetlands in the Middle East region established the feasibility and parameters for their development. All the natural wetlands and evaporation ponds with potential for conversion to constructed wetlands were mapped in the Kingdom and on Aramco reservation land.

Using Aramco's bespoke biodiversity heat map for the Kingdom, we identified the most important natural wetlands on Company land to protect. This led to the designation of a new wetland Biodiversity Protection Area in 2022.

We will continue designating priority natural wetlands as Biodiversity Protection Areas. We are also developing ecosystem service assessments to measure the full range of benefits from constructed wetlands in addition to their wastewater treatment and energy efficiency attributes.

What are we doing?

Manifa Bay

At the 2022 Middle East Energy Awards, Aramco won the Upstream Project of the Year Award, for its development, management, and production of the Manifa field, and its innovative solutions for protecting the fragile marine ecosystem in Manifa Bay.

When planning the development of the Manifa field, residents and fishing communities of Manifa Bay were considered carefully, using a multifaceted approach to field development and balancing sustainable production operations with the preservation of Manifa Bay's ecosystem.



Minimizing environmental impact

Nature-based solutions

Nature-based solutions are actions that protect, sustainably manage and restore natural and modified ecosystems in ways that address societal challenges effectively and adaptively, to provide both human well-being and biodiversity benefits.

Mangrove forests are one of nature's most powerful ecosystems, providing life-sustaining habitats for plants, birds, nursery areas for marine life, and supporting local communities relying on these productive ecosystems for their food security and well-being.

They may also serve as an underwater nursery where juvenile fish and shrimp can grow in relative security before venturing out into the open ocean. Also, the complex and deep descending mangroves' root structures can prevent shoreline erosion from waves and heavy storm surges, providing a natural adaptation to climate change impacts.

As vast stretches of Saudi Arabia's coastline are suitable for this forestation (and reforestation), we have invested significant resources in planting millions of mangroves.

Tree planting using drones

We have piloted drone technology for planting native trees and monitoring growth of these trees and the mangroves.

The pilot:

- Enabled seed germination technique for drone plantation;
- Conducted soil and water analysis;
- Planted 100,000 native trees using drones; and
- Achieved a plantation success rate exceeding 88%.

Coral reefs

Coral reefs are the most diverse ecosystems in the world. Aramco has been actively promoting the growth of marine life with artificial reefs. In addition to the offshore oil and gas facilities that act as artificial reefs by providing substrate for marine communities, we are working together with the Okinawa Coral Reef Conservation Consortium, Japan. Building on 11 years of research, we conducted studies on how to restore coral reefs, and ran educational programs.

Aramco Singapore is working with the National Parks Board on the trial application of CoralAID Mineral Accretion units to enhance coral growth. Under this technology, corals are subjected to low-voltage electricity to stimulate their growth.

What are we doing?

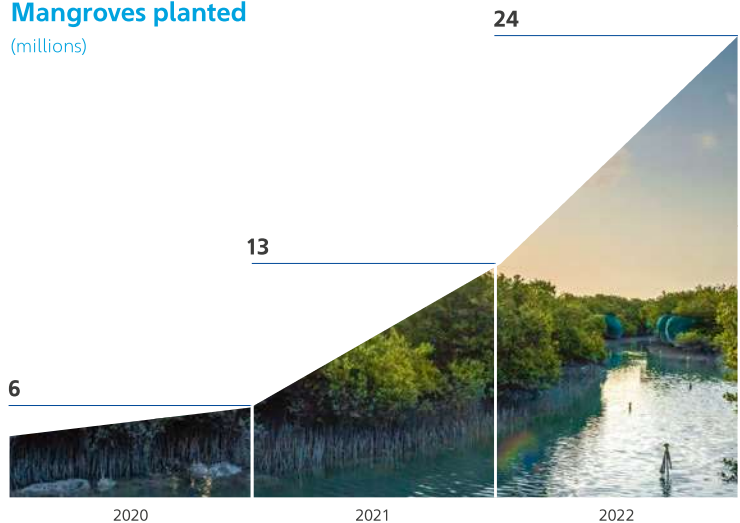
Mangroves

We have an ambition to plant 300 million mangroves in KSA and 350 million mangroves outside KSA by 2035. In 2022, we set an interim target to plant another 31 million mangroves along the Arabian Gulf and Red Sea shorelines by 2025. This plantation target will support marine ecosystems adjacent to the Company's operation in Abu Ali, Rahima, Yanbu', and Jazan.

To date, we have planted accumulatively 24 million mangroves.

Mangroves planted

(millions)



We are also helping to rescue and rebuild important reefs in the coastal waters of the United States, the Caribbean, and Mexico through grants by the National Fish and Wildlife Foundation's Coral Reef Conservation Fund.

Seaweed

Seaweed is a carbon negative crop and has a high potential for climate change mitigation. The Intergovernmental Panel of Climate Change (IPCC) *Special Report on the Ocean and Cryosphere in a Changing Climate* recommends "further research attention" as a mitigation tactic. We developed a sustainable seaweed farming facility at Yanbu', and to date, we have spent over \$1.5 million using this project to remove GHG and NOx by producing macro algae (seaweed). The laboratory, nursery and workshop have been built, but the farm is still under development.

11 million
mangroves and
1 million
trees were planted
in 2022

Water management

Aramco's approach to water

Headquartered in one of the most arid environments in the world, water management has been an essential focus of our business since our inception. Today, that means:

- Assigning an economic value to groundwater allocated for projects to incentivize the use of alternative sources;
- Reducing our dependence on groundwater by using alternative water sources, such as seawater, treated sewage effluent, and treated reject streams, including significant investment in desalination; and
- Ensuring the safety of the drinking water supply for our own and our host communities through water safety plans, which require the producer to conduct comprehensive risk assessments from the source to the consumer tap.

In 2022, we completed the utilization of treated sewage effluent as make up water for cooling systems across several air conditioning plants in our communities. We also evaluated and deployed water efficient irrigation technologies to reduce irrigation water demand. Hydrogel technologies were deployed at the Khurais Producing facility and the irrigation water demand at that site is expected to reduce substantially as the technology increases water holding capacity, aeration balance and improves soil structure. We also conducted water conservation assessments to reduce freshwater consumption through the identification of gaps, and the implementation of best practices and water conservation initiatives.

As part of our efforts to improve our monitoring and reporting of all our operations, we expanded the reporting boundaries of our two water metrics¹ from Company in-Kingdom only to operational control for 2022. During the year, our freshwater consumption was 93.6² million m³; a small decrease from the prior year (94.6 million m³) and our freshwater withdrawn fell by 3.5% (136.6 million m³ in 2022 compared to 137.3 million m³ in 2021). The slightly lower trend in freshwater withdrawn performance is mainly due to our continued water conservation efforts, despite the increase in production.

Deploying new technologies to conserve groundwater

Two technologies were pilot tested in 2022:

- 1 Crude desalting technologies were deployed at several of our facilities to enhance the process, improve crude quality, and optimize de-emulsifier consumption, reducing demand for wash water, thereby reducing the consumption of groundwater.
- 2 Produced water treatment technologies, in which a high salinity water is pretreated then desalinated using one of these processes, eliminating the need to use groundwater as wash water altogether.

In 2022, we recorded

47%

reduction in our hydrocarbon discharge to water

Wastewater and discharges to water

We recognize the need to responsibly manage and treat water prior to returning it to the environment, and have a comprehensive wastewater effluents management program.

Sustained performance has been achieved over the years by maintaining figures within targets. In 2022, we recorded a 47% reduction (16.4² barrels in 2022 versus 30.7 barrels in 2021) in our hydrocarbon discharge to water (HC2W). This is as a result of various activities, including:

- Pro-active measures to avoid any incidental discharge;
- Preventive maintenance of aging equipment; and
- Enhanced monitoring and tracking of the metrics through the HC2W corporate dashboard.

	2022	2021	2020
Hydrocarbon discharge to water ¹ (barrels)	16.4²	30.7	20.2
Freshwater consumption ¹ (million m ³)	93.6²	94.6	90.2
Freshwater withdrawal ¹ (million m ³)	136.6	137.3	142.9

1. As we progress on our reporting journey and our controls around ESG data mature, for this metric, we have expanded the reporting boundary from Company in-Kingdom to operational control. To allow comparability, we have restated the 2021 and 2020 figures in line with the expanded reporting boundary.

2. This figure has undergone external limited assurance in accordance to the ISAE 3000 (revised). The assurance report can be found [online here](#).

Minimizing environmental impact

The Company continues monitoring hydrocarbon discharge to water data through the HC2W dashboard. In 2022, we further developed the dashboard to enhance the use of data and reduce the chance of error while reporting data.

The HC2W metric is the total amount of hydrocarbons in barrels (bbl) that the Company systematically releases to surface water through regulated industrial wastewater discharge and excludes hydrocarbon releases from accidental oil spills, which are tracked separately. This has given us greater control over the wastewater we generate, thereby enhancing our capacity to improve water quality by reducing pollution, eliminating dumping and minimizing the release of hazardous chemicals and materials. Since 2021, the Company has been holding workshops with relevant facilities to provide clear guidelines of the reporting methodology.

In 2022, we also augmented our management processes with updates to our Company's asset integrity, process safety and prevention measures. These measures enhance our precautionary approach and risk management practices toward the environmental management of our operations, which require us to maintain specific environmental assessments and promote these best practices with our supply chain partners.

Drilling fluids recycling

Over the years, we have continued using drilling fluids recycling techniques, where properties of drilling fluids such as oil-based, water-based, and brine-based fluids are adjusted to fulfill specific operational requirements, as well as completion activities. These fluids are stored after being used, and in many cases treated, to be used on other wells, avoiding building new volumes from the scratch.

As part of our effort, and to share lessons with other energy companies, we are a member of Ipieca's Water Working Group.

What are we doing?

Winner at the World Oil Awards

At the 2022 World Oil Awards, Aramco won The Best Water Management Technology Award for the Zero Liquid Discharge Technology. With relatively large volumes of water produced along with hydrocarbons in oil and gas fields, a sustainable produced water management solution was developed and piloted to recycle and reuse water by transforming its ionic properties. The technology comprises a unique combination of a custom-designed pretreatment system to remove residual oil, hydrogen sulfide, and a dynamic vapor recovery technology for salt removal from hypersaline oil field produced waters.

Such technology would enable the adequate and effective recycling and reusing of produced water.



What are we doing?

Avoiding groundwater use at Jafurah

Our plans for the development of the Jafurah unconventional gas field (a gigantic basin with an estimated 200 trillion standard cubic feet of gas, with wells drilled with long horizontal lateral lengths, which require significant water use) incorporate avoiding the need to draw on groundwater by building a dedicated seawater treatment facility to supply enough water for the process.



Waste management

Aramco's approach to waste

In 2022, we developed a Corporate Waste Management Strategy with a goal to minimize and divert waste from landfill and provide short- and long-term targets. The strategy has incorporated national waste management targets for minimizing waste disposal to landfills and maximizing recycling and energy recovery within the Company and within the framework of a circular economy and digital transformation. Additionally, we have enhanced the online corporate waste management system for better data capture and reporting.

Our waste management strategy is the foundation for waste generated by Aramco in five focus areas: municipal, industrial, drilling, naturally occurring radioactive material (NORM), and plastic waste management.

Industrial waste

We continue to conduct waste minimization assessment studies as part of a project's Environmental Impact Assessment, including existing facilities. These studies identify opportunities to eliminate or minimize waste. As for operating facilities, Aramco performs waste minimization opportunity assessments three to five years after commissioning.

Our waste management is guided by the Aramco Hazardous Waste Code, which has been prepared to define consistent requirements and best practices for the management of waste materials that are considered hazardous to human health or the environment, due to their ignitability, reactivity, corrosivity, or toxicity. These Company requirements are in accordance with the recently published Saudi Government regulations (Environmental Law, Waste Management Law and their regulations).

We employ the waste management hierarchy to manage our waste, which ranks waste management options in a manner that minimizes environmental impacts and supports circular economy objectives. Waste is categorized into three management streams: hazardous, non-hazardous (including municipal), and inert. Management options are ranked by their potential environmental impact, with the highest priority accorded to waste prevention and reduction.

In 2022, Aramco generated 318,656 metric tonnes of industrial waste (2021: 240,225) which was disposed of at licensed and Company

What are we doing?

Automated NORM waste management

Naturally occurring radioactive material occurs across a variety of oil and gas waste streams, including in sludge from oil/gas separation and in debris from pipeline scrapings. In 2022, we initiated a system to track NORM waste from generation to storage and to final disposal by utilizing radio frequency identification (RFID) tracking technology. This will interface with our SAP waste manifesting and provide a real-time NORM inventory, shifting from a manual process to a fully automated one, delivering detailed information of each NORM waste container from our facilities. The system enhances our accountability and ensures compliance with government regulations.

	2022	2021	2020
Industrial waste generated ¹ (metric tonnes)	318,656	240,225	313,348
Industrial waste recycled* (%)	39.9²	39.8	49.5

qualified industrial waste management service providers. The increase in waste has been driven by an increase in our hydrocarbon production and the oil spills during the year. In 2022, we recycled* 39.9%² of our industrial waste (an increase in waste recycled compared to the prior year, despite the 33% rise in industrial waste).

Measures that have contributed to the increase in recycling, primarily of oily wastewater and oily sludge waste streams, include adopting industry best practices and technologies for managing generated industrial waste and recovering hydrocarbons, such as automatic tank cleaning methods. Based on our strict quality criteria when selecting third-party partners, we included 18 industrial waste transporters and 12 industrial waste management third-party service providers for efficient disposal of our waste.

We have initiated a process of setting internal targets for recycling industrial waste. We also identified an opportunity for recycling spent-claus catalyst through the cement industry.

We are trialling a technology that can be used to condition NORM waste and recover material from the NORM waste stream, including hydrocarbons and water.

* Metric reported for the first time externally.

1. As we progress on our reporting journey and our controls around ESG data mature, for this metric, we have expanded the reporting boundary beyond just Company in-Kingdom. To allow comparability, we have restated the 2021 and 2020 figures in line with the expanded reporting boundary.

2. This figure has undergone external limited assurance in accordance to the ISAE 3000 (revised). The assurance report can be found [online here](#).



Through our Namaan industrial investment arm, we launched IK Metals Reclamation and Catalyst Manufacturing as a non-equity investor. With a consortium of investors, the state-of-the-art recycling complex will integrate manufacturing facilities for fresh residue upgrading for catalysts and energy storage batteries in the Kingdom.

The IK Supercenter is planned across three discrete phases:

- Phase 1** Phase 1 will see the construction of hydrometallurgical technology for vanadium reclamation to be used for producing vanadium electrolytes, for use in energy storage batteries.
- Phase 2** Phase 2 will see the expansion of the IK Supercenter to include a hybrid hydro-pyrometallurgical technology for metals reclamation of spent residue upgrading catalyst feedstock.
- Phase 3** Phase 3 will further expand the IK Supercenter to include a fresh residue upgrading catalyst manufacturing facility.

What are we doing?

SafeChem

Some chemicals used in our operations are rated as high security concerns and need to be tracked and reported to the relevant governmental entity. SafeChem, an IR 4.0 solution, was developed to track chemicals of government security concern throughout their life cycle across our facilities. Utilizing RFID technology, chemicals can be tracked in real-time providing accurate information about their inventory, consumption, transportation, disposal, and location.

Municipal waste

Aramco has established a joint venture with Veolia, an international waste, water, and energy management company, to develop an integrated waste management facility in the Kingdom. The facility is intended to treat all of the Company's municipal and industrial waste generated in the Kingdom, and in the future expand to treat other wastes in the Kingdom and the region. A suitable site for the first phase of the project has been identified and all necessary geotechnical and environmental impact assessment studies have been carried out. Waste characterization studies, masterplans for both municipal and industrial wastes, and feasibility studies to identify the best available technologies to maximize recycling and minimize disposal to landfill have also been completed.

Plastic waste management

Our vision is to play a meaningful role in eliminating plastic waste and leakage to the environment, and it is informed by four key points:

- 1 The demand for plastic is projected to grow faster than the available supply of recycled materials due to increasing population, urbanization and economic development.
- 2 Plastic waste cannot be solved only by consuming less and recycling more — we need a re-engineering of the whole plastic value chain.
- 3 Plastic products need to be better designed with a focus on circularity with greater efficiency, reusability and improved recyclability.
- 4 Innovative technologies, such as the “refinery of the future” concept can address reusability by converting plastic waste into sustainable fuels or adopting chemical recycling technologies.

Aramco continues to promote the use of recycled plastics in the construction industry. For example, synthetic rubber from waste tyres was deployed in asphalt pavement construction as a partial replacement to bitumen (up to 10%).

We are also exploring methods and ways to increase the circular economy in the plastic industry in collaboration with key stakeholders, including recycling companies and local authorities.

We are currently assessing the development of a plastic recycling investment that aims to recycle post-consumer waste plastic into recycled pellets.



With our subsidiary SABIC, we are developing alternative uses for plastic waste and its recovery, ranging from mechanical to chemical recycling and new material design to provide more circular plastics.

Durable and non-metallic materials are an integral part of the auto industry, and demand is expected to grow significantly as we transition to hybrid and electric vehicles. Most of the plastics used in automobiles come from polymers — and our affiliate, SABIC, introduced the world’s first circular polymer.

In addition to our individual efforts to address the challenges related to plastic waste management, we support involvement with collective prevention work directly or via our subsidiaries. We partner or engage with a range of industry associations, regulators, and non-government bodies.