Minimizing environmental impact

We strive to conserve natural resources and minimize the environmental footprint of our businesses' activities by leveraging technology and promoting industry best practice.

Why it is important

From biodiversity to emissions, waste management and water tables, industry must ensure that it minimizes its impact on the natural environment, a common, shared resource for all humanity.

Our ambition

We aspire to not only limit our environmental footprint, but to have a legacy of projects that improve both natural habitats and shared resources.

Our approach

We are incorporating circular carbon economy principles across our value chain — a viable economic prospect for the global economy. Our Company is seizing this business opportunity by proactively moving to this operating model.

Our plans

We will continue to embed in our strategy and planning the consideration of environmental protection and circular carbon economy principles, alongside financial, production, and business output metrics.

Material topics	Relevant UN SDG	Relevant metric
Biodiversity and ecosystems		Biodiversity is a material issue that has a broad relationship with various KPIs and has a strong impact on our day-to-day business and operations, therefore we are applying a deliberately phased approach to ensure the quality and integrity of our data capture and target-setting processes, thus for 2021, there are no publicly reported KPIs.
Water		Freshwater consumption/withdrawal (million m^3) – pg 69. Hydrocarbon content discharged to water (HC2W) (barrels) – pg 71.
Waste management		Industrial waste generated (metric tons) – pg 66.
Local environmental impact		SOx emissions (kilo tons) – pg 65. Number of hydrocarbon spills – pg 71. Volume of hydrocarbon spills (barrels) – pg 71.

For more details on relevant metrics **see page 88**

Environmental standards and regulations

Before commencing a project, we strive to conduct environmental impact assessments in accordance with the relevant environmental regulations, standards and Company requirements, including comprehensive biodiversity surveys in ecologically sensitive areas, with the fundamental objective of minimizing impacts. These studies identify potential environmental impacts, the appropriate actions and means to prevent or minimize negative effects, or appropriate actions to increase the project's positive returns to the environment.

For any project that requires international funding, we conduct Environmental, Social and Health Impact Assessments, in compliance with the International Finance Corporation's (IFC) Performance Standards. We follow international best practices and local environmental regulations to develop project site closure and rehabilitation plans to minimize the environmental and health impacts associated with out- of-service plants and affected sites. These best practices include mitigation and monitoring plans that focus on effective site closure, rehabilitation, and restoration. We ensure that final asset disposal and remedial obligations comply with relevant environmental legislation, regularly updating closure plans to restore land use for the community.

$800 million

We are planning to invest $800 million over the next two years for two major projects installing Vapor Recovery Units and Vapor Handling Facilities.

Corporate circular economy roll out program

In January 2021, we commenced the roll out of a corporate execution plan of Circular Economy. To facilitate an accelerated and systematic implementation across Company departments, its seven principle strategies have been linked to the Company Operational Excellence system. Multiple Departments have collectively developed potential circular opportunities and incorporated them in their business plan. Moreover, the taskforce team have developed a comprehensive circularity assessment methodology to measure Departments' level of circularity in terms of key enabling elements as well as performance measures.

SOx, NOx, and VOCs

We have set design and operational emission thresholds for sulfur oxide (SOx), nitrogen oxides (NOx), and volatile organic compounds (VOCs) emissions and have a system in place to monitor those emissions and ensure that the applicable Government and Company standards are complied with across our activities.

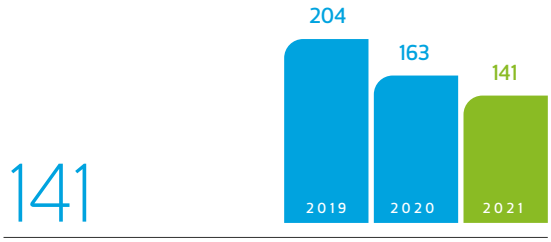
The monitoring system includes a network of Air Quality and Meteorology Monitoring Network (AMMNET) stations that track ambient air quality. We plan to include air emissions monitoring in our newly deployed Emissions Monitoring Solution, which currently tracks GHG emissions across the Company, and is linked with the 4th Industrial Revolution Center.

As our operations utilize sales gas[1] as a primary fuel to fire the combustion units, we are replacing old NOx burners with low NOx and ultra-low NOx burners to further reduce NOx emissions.

1. Natural gas after processing to remove condensates, CO_2, and liquefied petroleum gas.

SOx emissions

Kilo tons



With respect to VOCs, we are implementing a vapor recovery system (VRS) project to minimize emissions of VOCs from our bulk loading operations, including new and old refined product distribution depots.

Aramco manages SO2 emissions as part of its air quality strategy which is covered under the environmental master plan. The Company's internal design and operational practices are consistent with international standards and emissions are monitored to ensure compliance with regulatory standards. There is further work required at some of our facilities to ensure compliance, which we are undertaking.

We have begun making investments to further reduce SOx emissions by enhancing sulfur recovery, for example with sulfur recovery units in refining and gas plants, in tail gas treatment facilities (TGTU) at Fadhili Gas Plant and Jazan Refinery. Sulfur recovery with TGTU is capable of achieving recovery efficiencies above 99.9% to minimize SO2 emissions. Performance is forecast to improve further as we roll out TGTU across additional Company assets.

Waste management

We employ the waste management hierarchy to manage Company-generated waste. The waste hierarchy ranks waste management options in a manner that minimizes environmental impacts and supports circular economy objectives, which minimizes our resource utilization and environmental footprint. 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, followed by reuse, recycling, recovery, and proper treatment and disposal.

Aramco is establishing a joint venture with an international partner to develop a waste management project in the Kingdom. The project is intended to treat all Aramco municipal and industrial waste generated in the Kingdom, and to be expanded to other wastes in the Kingdom and the region in the future.

Industrial waste

To minimize the generation of industrial waste at the source, we conduct a waste minimization assessment study as part of a projects' Environmental Impact Assessment. The study identifies, at the preliminary design stage, opportunities to eliminate or minimize waste generation. As for operating facilities, Aramco performs waste minimization opportunity assessments three to five years post commissioning.

In-Company waste management is guided by the Saudi Aramco Hazardous Waste Code (HWC) which has been prepared to define consistent requirements and best practices for the management of Company waste materials that are considered hazardous to human health or the environment due to their ignitability, reactivity, corrosivity, or toxicity.

Similarly, the Solid Waste Landfill Requirements Engineering Standard prescribes the minimum requirements for the design, site selection, operation, monitoring, and closure of Class II and Class III solid waste landfills to meet Governmental landfill design and operation requirements. In 2021, Aramco generated 158,000 tons of industrial waste (2020: 231,000 tons)

In the fourth quarter of 2021, Aramco developed and endorsed a Corporate Waste Management initiative that can be used to develop short-, mid-, and long-term sustainable waste management programs. The strategy includes sustainable industrial waste management programs incorporating targets for minimizing waste generation and disposal to landfills, maximizing industrial waste recycling and energy recovery opportunities.

Plastic waste management

Plastic materials have contributed to global economic growth thanks to their low cost, versatility, durability, strength, hygiene, and light weight.

Across 2020 and 2021, plastics' essential benefits to human health were vividly illustrated through the masks, gloves, and medical personal protective equipment, which were essential to combating the spread of COVID-19.

Simply put, without plastics, the world could not combat the virus' spread, including delivering ventilators and the myriad other medical products required, such as vaccine syringes and the refrigerators needed to store and protect the vaccine, without significant additional cost and effort.

What are we doing?

Waste monitoring

Aramco has started deploying online analyzers to enhance monitoring and reporting of our waste KPI. The analyzers are linked to the Hydrocarbon Discharge to Water (HC2W) corporate dashboard, supported by our IT infrastructure, to monitor real-time data and enable facilities to take immediate corrective actions when non-compliance or process upsets are observed.

What are we doing?

A circular economy for used plastics

Through SABIC's TRUCIRCLE™ initiative, we continue to challenge open-ended value chains, driving forward a circular economy for used plastics.

In 2021, Frost & Sullivan, a leading business consultancy, named SABIC "Global Company of the Year" for sustainability practices and circular economy. SABIC is a founding member of the Alliance to End Plastic Waste, and it remains committed to finding innovative solutions to help transform industry from a linear economy to a circular one and serving as best-practice examples that raise the standards of the chemicals industry as a whole.

Plastics offer a unique combination of durability, versatility, and low cost, which made them the material of choice for many everyday materials. However, with the wide use of plastic, particularly single-use plastic, the world urgently needs to address the resulting mishandled waste.

Addressing plastic waste in the environment requires the participation and long-term commitment of all members of society, including government, civil society, consumers, manufacturers, technology developers, and the finance community. No one country, company, or community can solve this problem on their own.

Our approach and actions

Our vision is to have an impactful role in eliminating plastic waste and leakage to the environment.

With our acquisition of a 70% equity interest in SABIC, Aramco incorporated into its business one of the world's largest petrochemicals manufacturers. For our Company, this ushers in a new era of innovation to enhance competitiveness and benefit customers, employees, and shareholders.

Through SABIC, we are progressively implementing a sustainable plastic waste management model, which we expect will result in a greater net positive impact on business, society, and the environment.

With innovation as a core capability, Aramco and SABIC are developing novel solutions and alternative uses for plastic waste. Together we are partnering in research, development, and deploying a wide range of technology solutions for plastic waste, ranging from mechanical to chemical recycling and new material design to produce circular plastics: turning plastic waste into a resource through aggregation, processing, and recycling through advanced and innovative technologies.

SABIC launched the TRUCIRCLE™ framework to help close the loop on plastic recycling. TRUCIRCLE™ encompasses the company's circular materials and technologies, including certified circular polymers from the chemical recycling of mixed plastic waste.

Aramco has developed technology to repurpose plastic waste for use in construction applications such as road paving. For example, we turn local waste plastic into recycled plastic asphalt for use in the Kingdom's road pavement construction and maintenance. We are also exploring opportunities to convert mixed plastic waste into fuels, synthesize gas, hydrogen, and power.

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

Water management

With our roots in Saudi Arabia's desert climate, Aramco has long recognized the importance of preserving water. From an early stage, water management has been a key pillar in the Company's long-term strategy.

The Company's comprehensive water conservation efforts entail supplementing water supply with alternative sources, implementing water efficient practices, maximizing wastewater reuse, and minimizing water losses. One of the ways in which we avoid the waste of this precious resource is by using seawater as Aramco's primary source of water for pressure support and "sweep" of oil reservoirs. Our commitment to sustainable use of water resources is assured through implementation of the Company Water Conservation Policy, which has been in place since 2011 and is overseen by HSSE Committee at the Company-level.

We seek to reduce our dependence on non-renewable groundwater by using alternative water sources like seawater, treated sewage effluent, and treated reject streams, including significant investment in desalination. A testimony to this strategy is our large seawater treatment and injection network of facilities. For example, in late 2020, on the western border of Ghawar, what we believe to be the world's largest oil and gas field, five newly constructed giant sulfate removal units went into operation, allowing us to treat and utilize seawater instead of groundwater to support oil production. This 100,000 m^2 facility pumps pre-treated high-pressure Gulf waters supplied from Aramco's Qurayyah Sea Water Plant across the sulfate removal membrane systems prior to injection into Ghawar's 'Ain Dar and Fazran fields.

At Khurais, we commissioned a 60,000-barrel-per-day seawater reverse osmosis facility, ending the use of groundwater in plant processes. Developing unconventional fields can be water intensive, one of the latest innovative approaches for conserving groundwater is the use of Treated Sewage Effluent (TSE) for operations at Aramco's Jafurah unconventional gas field, the largest non-associated gas field in Saudi Arabia. To support future developments of the field, our aim is to build a dedicated seawater treatment facility to supply all water needed for stimulation operations, avoiding the need to deplete fresh groundwater supplies.

What are we doing?

Sustainable water management for oil production

The Qurayyah Sea Water Plant (QSWP) is the largest operation of its type in the world with an expansive network of facilities across the Company's fields. It treats seawater and transports it to many fields for pressure maintenance, thus preserving valuable groundwater and helping protect marine life. Its scale is unparalleled: its annual maximum capacity of groundwater savings is equivalent to the entire industrial sector's annual groundwater demand in Saudi Arabia.

Company water conservation performance is monitored through reviewing water conservation data and key performance metrics, conducting water optimization studies on capital projects and assessing Company operating facilities for compliance. In 2021, the Company's freshwater[1] consumption (FWC) was 33.8 million cubic meters compared to 32.9 in 2020. The increase in FWC performance in 2021 was mainly due to inclusion of water use by well completion activities in upstream operations.

We embed water conservation in our business approach and operate multiple programs focused on protecting our water resources, including:

- Conserving water resources and maximizing their availability to future generations, including the use of desalinated water at our operating fields.
- Establishing and implementing a groundwater protection program which applies strict measures that prevent company operations from impacting groundwater.
- Establishing procedures for compliance with discharge standards and regulations.
- Ensuring the safety of drinking water supply for our own and our host communities by following our Water Safety Plan.
- A value for groundwater is assigned in projects to incentivize the use of alternative sources.

1. The total dissolved solids (TDS) concentration of this type of water is up to 2000 mg/L.

Wastewater and discharges to water

Our goal is to avoid and minimize generation of wastewater from operations through project design and reservoir management. State-of-the-art simulation models that allow optimal placements of wells and advanced well completion technologies minimize water production, reducing the energy required to process wastewater, thereby lowering GHG emissions.

We recognize the need for responsibly managing and treating water prior to returning it to the environment. In order to address the challenges of continually expanding Company operations and meet stringent environmental regulations, a comprehensive wastewater effluents management program is in place with the aim of protecting the environment and public health.

The Hydrocarbon content discharged to water (HC2W) KPI is used to continually reduce the level of hydrocarbons discharged through wastewater effluents by maintaining a vigilant wastewater discharges monitoring program. The KPI measures the total amount of hydrocarbons released to the surface water through the Company's industrial wastewater discharges and excludes hydrocarbon releases from accidental oil spill, which are tracked separately.

Performance over the years shows an overall positive hydrocarbon volume trend (reduction) and sustained performance while maintaining figures within target. In 2021, this was 5.4 barrels. This is as a result of actions implemented by the Company, including:

- Pro-active measures to avoid any incidental discharge in their processes.
- Preventive maintenance of aging equipment.
- Enhanced monitoring and tracking of the KPI through the HC2W Corporate dashboard.

What are we doing?

Preserving groundwater

We plan to develop the Jafurah unconventional gas field, a gigantic, 17,000 km^2 basin with an estimated 200 trillion standard cubic feet of gas in place, by combining innovative technologies with the field's unique properties.

Jafurah wells are drilled with long horizontal lateral lengths to maximize hydrocarbon recovery, optimizing the well's productivity in the long-run. In the arid climate of Saudi Arabia, we will circumvent the need to draw on precious groundwater and instead build a dedicated seawater treatment facility to supply enough water for the process.

The treated seawater will be distributed throughout the field via a 180 km pipeline network, which will significantly reduce water-hauling truck traffic and result in a lower environmental impact and the overall carbon footprint.

Spills to the environment

We proactively manage operations to avoid hydrocarbon leaks and spills by maintaining asset integrity throughout their life cycle. This approach includes prevention, preparedness, and incident response.

In 2021, oil spills had a total volume of 14,447 bbl, including one major oil spill estimated to have a total volume of 14,000 bbl; one moderate oil spill with a total volume of 300 bbl; and eleven minor oil spill incidents greater than 1 bbl.

The major spill was at Safaniya-Khursaniya pipeline corridor that occurred on April 17th, 2021. This was caused by the burst of an oil pipeline. Around 95% of the spilled oil was recovered for re-processing through Safaniyah and Manifa facilities. Proper cleanup, disposal and restoration was undertaken to mitigate the spill's impact and restore the affected areas.

	2021	2020	2019
Number of Hydrocarbon Spills	**13**	6	11
Volume of Hydrocarbon Spills (barrels (bbl))	**14,447**	134	38

Biodiversity

Biodiversity encompasses the variability among living organisms including:

- terrestrial, marine and other aquatic ecosystems;
- ecological complexes, and
- diversity within species (e.g. genetic variability), between species, and of ecosystems.

In Saudi Arabia, there is a rich diversity of wild animals and plants. There have been 499 species of birds recorded in the Kingdom, along with 117 mammal species, 107 reptile species, 266 coral reef species, 1,230 fish species, eight amphibian species, and over 2,400 flowering plant species.

In March 2021, the Company's first Biodiversity Protection Policy was approved, with the objective of achieving a net positive impact on biodiversity and ecosystem services.

The Company's commitment to delivering positive impact biodiversity and ecosystem services in its operational areas supports the Saudi Green Initiative and is informed by IPIECA's guidance and UN SDGs. We are updating procedural operating instructions and guidance as well as capacity building, embedding biodiversity project delivery milestones and conducting research with experts in the field.

Biodiversity protection hierarchy

To achieve a net positive impact on biodiversity we are using the hierarchical approach to mitigation and compensation (where required) for the Company's impacts by:

- Seeking;
- Avoiding;
- Minimizing;
- Restoring; and where necessary
- Offsetting any loss to biodiversity or ecosystem.

Marine protection

Aramco welcomes the U.N. drawing attention to the vital importance of marine environments and recognizes the need for action on multiple fronts to protect life and livelihoods. The projects Aramco has launched to protect marine ecosystems are global in scope, with a focus on coral-reef regeneration and mangrove restoration, particularly in the Red Sea and the Arabian Gulf.

Our scientists and experts have been collecting valuable information regarding wave height, currents, dissolved oxygen, water temperature, clarity, salinity and the concentration of chlorophyll, the pigment that provides energy for photosynthesis. Aramco is helping the global scientific community by giving free access to this data to support other environmental projects, and we are already partnering with several international organizations, such as the C4IR Ocean and its Ocean Data Platform, to further this aim.

Regenerating coral reefs

In terms of our projects, we have supported the regeneration of endangered coral reefs. Around the world, these precious and fragile ecosystems — which provide a habitat for hundreds of marine species while also forming a natural barrier against coastal erosion — have become degraded. This damage has multiple causes, including coastal and offshore development, illegal fishing practices, pollution, and the rise in sea temperatures caused by climate change.

In the Arabian Gulf, for example, most coral communities are in the vicinity of offshore islands, and we realized one of the factors preventing damaged reefs from regenerating was a lack of hard ground on which the coral could reform. We therefore designed and built a series of strong and stable artificial reef structures on the seabed, which the coral could then recolonize, providing a new habitat for a wide variety of marine organisms. Our scientists closely monitor these regenerated reefs, which we believe have been a great success: fish are thriving and the variety of marine life has increased, while the reefs are more resilient.

The Saudi Green Initiative

SAUDI GREEN INITIATIVE

The Saudi Green initiative encompasses the following ambitious targets:

- Increase the share of renewables in the Kingdom's energy mix from 0.3% to 50% by 2030.
- Reduce carbon emissions by more than 4% of global contributions, building on an existing commitment to avoid more than 278 MT of CO_2 by 2030.
- Plant 10 billion trees over the coming decades — this addresses desertification, which is a country and regional economic risk to the Kingdom with an estimate that billions of Saudi Riyals are currently lost due to dust storms in the region every year. This tree planting is equivalent to rehabilitating roughly 40 million hectares of degraded lands, translating to a twelvefold increase from current tree cover and meets 1% of UNEP's global target to plant 1 trillion trees.
- Increase the percentage of protected areas to more than 30% of Saudi land area, representing roughly 600,000 km^2, in addition to launching a number of ambitious initiatives to protect marine and coastal environments.

We fully endorse and support the Saudi Green Initiative.

What are we doing?

Mangroves

In January 2021, we opened our Mangrove Eco-Park — the first facility in Saudi Arabia dedicated to the preservation of old growth mangrove forests.

The 63 km^2 Mangrove Eco-Park protects one of the last naturally occurring mangrove forests in the Eastern Province of Saudi Arabia and features the longest mangrove boardwalk in the country.

The park has also been designed to educate the community — from school-children to families and visiting tourists — about mangroves and their environmental benefits.

In 2021 alone, we planted 7 million mangrove seedlings.

Nature-based solutions

Nature-based solutions are actions to "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"[1]. Over the last decade, Aramco has embraced this concept, initially planting two million mangrove plants along the shores of the Arabian Gulf coast to restore the coastline. Aramco is now accelerating efforts in planting mangroves and have increased the number of planted mangroves in the Kingdom to over 13.3 million plants along the shores of the Arabian Gulf and Red Sea.

In 2018, the Company launched an initiative to plant one million native trees throughout the Kingdom. This goal was reached in 2021. 26 types of native tree have been planted and are sustained with excess treated sewage water.

In addition to benefits for biodiversity, combatting desertification and restoring coastlines, these projects also create natural sinks for CO_2. Mangrove forests, particularly, are one of nature's most powerful ecosystems, living in conditions that no other tree thrives and connecting the land and the sea. They are an important nature-climate solution towards mitigating climate change and contribute to our decarbonization actions. See also the section on Natural Climate Solutions (page 47), on this topic.

1. IUCN — International Union for Conservation of Nature.

What are we doing?

Biodiversity protection

- We reserve high quality habitat: Aramco has designated ten sites as Biodiversity Protection Areas covering over 950 km^2. Together, these sites protect more than 500 species of plants and animals, including at least 55 species or subspecies that are unique to Arabia. Each of these sites contains regionally or internationally significant biodiversity, such as the presence of threatened, migratory, or endemic species. From Shaybah in the south, to Tanajib in the north, and from Abu Ali in the east to Abha in the west, these ten protected areas cover a diverse array of the Kingdom's unique ecosystems.
- We reduce negative impacts: The Company is continually improving its operations to ensure our activities minimize impacts on biodiversity wherever possible and the new Company guideline on biodiversity protection provides governance and further protective measures for biodiversity.
- We restore degraded habitat: We have reintroduced locally extinct species at Shaybah Wildlife Sanctuary, and restored degraded wetlands at Abqaiq.
- We create new habitat: Over the past two years, the Company developed nature reserves at Abqaiq and Haradh.
- We map and monitor key species: We have created digital habitat models that identify important biodiversity areas. These habitat models will ultimately be used to enable us to identify, prioritize, and reserve high quality habitat on Company land and reduce Company impacts on biodiversity.
- We invest in biodiversity education and awareness: In 2021 we opened educational visitor centers at the Mangrove Eco-Park in Tarut Bay and the Shaybah Wildlife Sanctuary in the Rub' al-Khali.
- We conduct applied research: We continue to conduct applied research aimed at ensuring Company activities do not cause undue impacts on biodiversity. For example, we continued our collaborative research partnerships with King Fahad University of Petroleum and Minerals (KFUPM) and King Abdullah University of Science and Technology (KAUST).

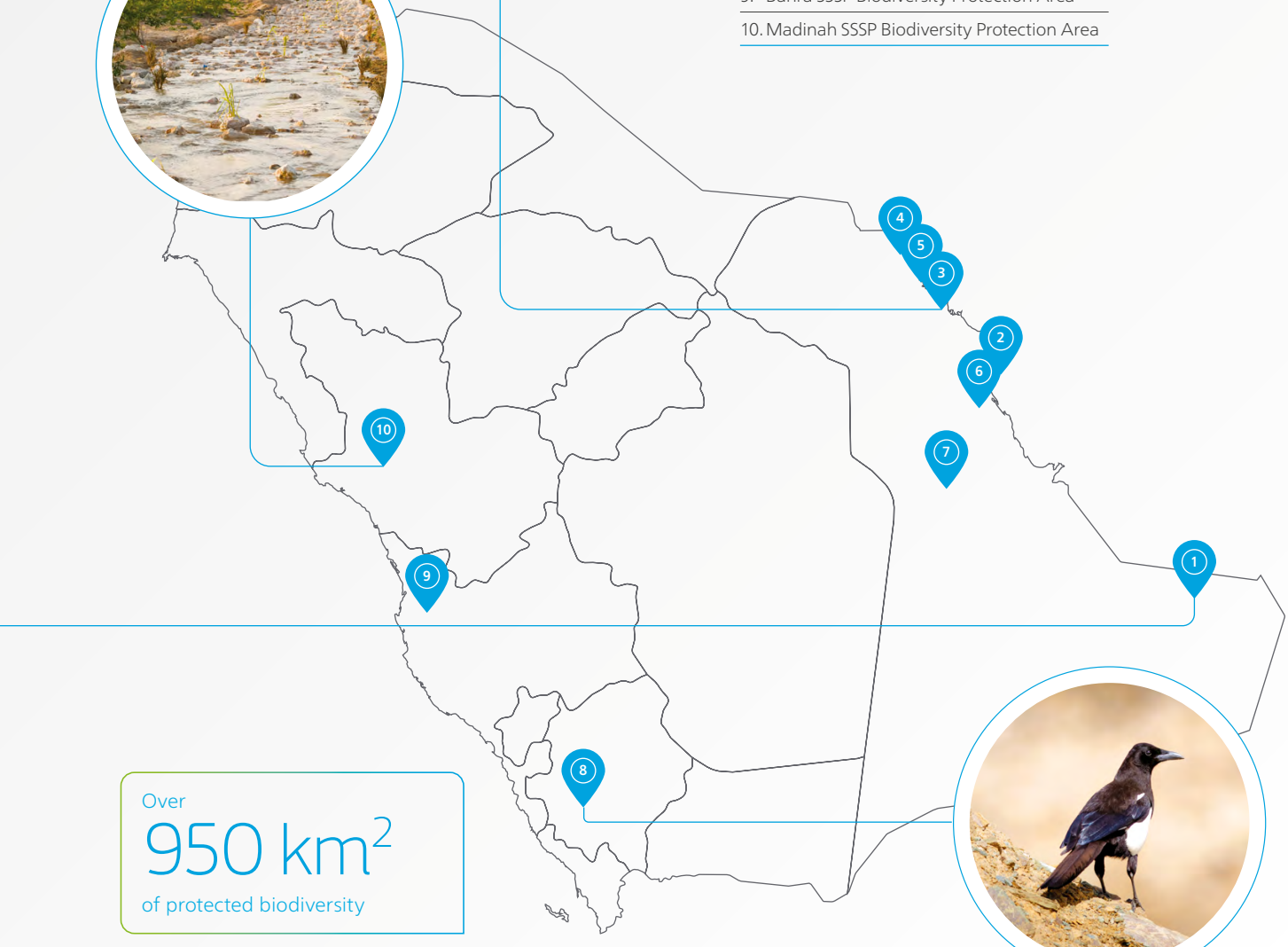
Shaybah Wildlife Sanctuary
The Shaybah Wildlife Sanctuary consists of a 637 km^2 fenced area of near pristine habitat in the Rub' al-Khali desert located 11 km west of our Shaybah Residential and Industrial Complex, which supports internationally significant wildlife. The perimeter fence helps eliminate key threats at the site, such as unregulated vehicle access, grazing, littering, and hunting but is designed to be permeable to wildlife.

Abqaiq wetlands
The Abqaiq wetlands of restored wetlands and dune habitat, which supports native wildlife and migratory birds. Biodiversity surveys have identified more than 49 bird species, 34 plant species, four mammal species, and six reptile species that take refuge at the site.

The wetlands were previously impacted by disposal of unregulated solid waste. Commencing in 2016, we removed the waste material, fenced the area to prevent additional dumping, invasive species and installed the Kingdom's first two birdwatching hides. The area now consists of reedy wetlands, sand dunes, and a planted tree belt to the west of our Abqaiq community.

Ten protected sites

1. Shaybah Wildlife Sanctuary
2. Rahima Bay Mangrove Eco-Park
3. Abu Ali Island
4. Tanajib Biodiversity Protection Area
5. Manifa Biodiversity Protection Area
6. Abqaiq Wetlands
7. 'Udhailiyah Biodiversity Protection Area
8. Abha SSSP Biodiversity Protection Area
9. Bahra SSSP Biodiversity Protection Area
10. Madinah SSSP Biodiversity Protection Area



Over
950 km^2
of protected biodiversity