

Environmental Workshops

24-26 January 2022



Paving The Way to Economic Success

Disclaimer

This presentation may contain certain forward-looking statements with respect to Saudi Aramco's (the "Company") financial position, results of operations and business, and certain of the Company's plans, intentions, expectations, assumptions, goals and beliefs. These statements include all matters that are not historical fact and generally, but not always, may be identified by the use of words such as "believes", "expects", "are expected to", "anticipates", "intends", "estimates", "should", "will", "shall", "may", "is likely to", "plans" or similar expressions, including variations and the negatives thereof or comparable terminology.

You should be aware that forward-looking statements are not guarantees of future performance and that the Company's actual financial position, results of operations and business, and the development of the industries in which it operates may differ materially from those made in or suggested by such forward-looking statements. Factors that could cause actual results to differ materially from the Company's expectations are contained in cautionary statements in the Company's Prospectus filed with the Saudi Arabian Capital Markets Authority and available at <https://cma.org.sa/en/Market/Prospectuses/Pages/default.aspx> (the "Prospectus") and include, among other things, the following:

- (1) oil and gas supply, demand and price fluctuations; (2) global economic market conditions; (3) competition in the industries in which the Company operates; (4) conditions affecting the transportation of products; (5) operational risk and hazards common in the oil and gas, refining and petrochemicals industries; (6) the cyclical nature of the oil and gas, refining and petrochemicals industries; (7) weather conditions; (8) political and social instability and unrest and actual or potential armed conflicts in the MENA region and other areas; (9) managing the Company's growth; (10) risks in connection with projects under development and recent and future acquisitions and joint ventures, including with respect to SABIC; (11) managing the Company's subsidiaries, joint operations, joint ventures, associates and entities in which it holds a minority interest; (12) the Company's exposure to interest rate risk and foreign exchange risk; (13) risks related to operating in a regulated industry and changes to oil, gas, environmental or other regulations that impact the industries in which the Company operates; and (14) international trade litigation, disputes or agreements.

Saudi Aramco's Annual Report contains a more complete discussion of the factors that could affect the Company's future performance and the industries in which it operates. The Company undertakes no obligation to update or revise any forward-looking statements, whether as a result of new information, future events or otherwise. All subsequent written and oral forward-looking statements attributable to the Company or to persons acting on its behalf are expressly qualified in their entirety by the cautionary statements referred to above.

iktva Program Overview

Environmental

The IN-KINGDOM TOTAL VALUE ADD (iktva) Program



70%
LOCAL CONTENT



THOUSANDS
OF JOBS



30%
EXPORTS

- Drives domestic value creation by working with suppliers for mutual benefit
- Envisions to improve investment, and maximize long-term economic growth and diversification
- Focuses on delivering quality jobs, advancing innovation and enhancing global competitiveness

IKTVA is designed to reward Saudi Aramco's suppliers for the use and development of local labor and sub-suppliers

iktva 2022

Agenda – Environmental Investment Opportunities

Environmental

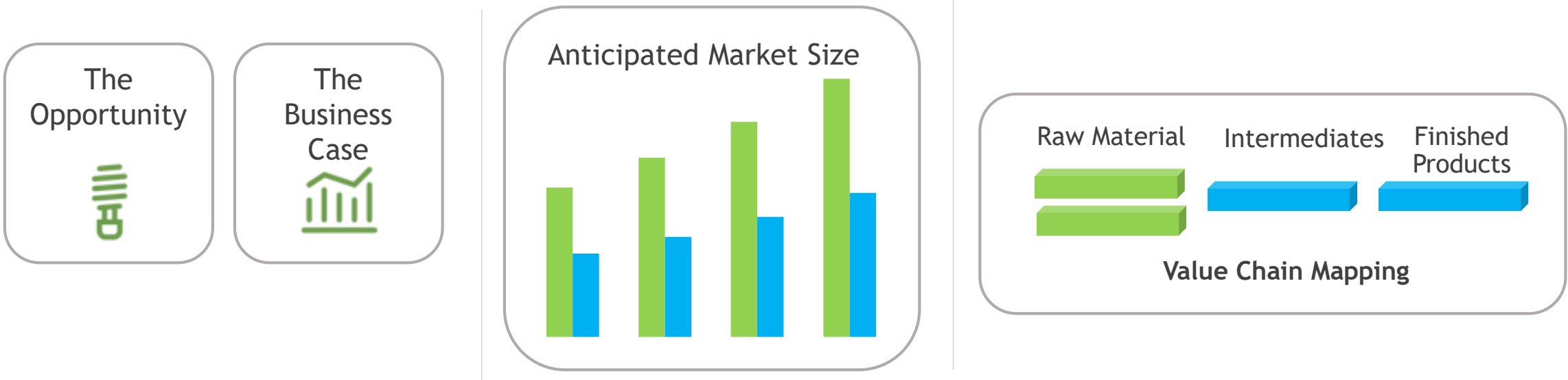
Session Title	Presenter
Opening	Omar Alkerishan, (ID&SSD)
1. Industrial Waste Management	Tamim Al-Buraikan (EP)
2. Radiation Protection Services	Michael Cowie (EP)
3. Naturally Occurring Radioactive Material (NORM) Disposal	Michael Cowie (EP)
4. Naturally Occurring Radioactive Material (NORM) Decontamination	Abdullah Alhammad (MLD)
5. Consumed Chemicals and Lubricant Oil (Reuse/Recycle)	Abdullah Alhammad (MLD)
6. Expired/Used Batteries (Re-use/Recycle)	Abdullah Alhammad (MLD)
6. Environmental Health Services	Hassan Alzain (EP)
7. Industrial Hygiene	Dr. Ahmed Al-Yami (EP)
8. Water and Wastewater Treatment	Sultan Alrubaish (P&CSD)
Closing	Omar Alkerishan (ID&SSD)

Environmental Session Outline

Environmental

25 Investment Opportunities

Each will provide:



Investment opportunities will cover environmental protection in the oil and gas industry sector

iktva 2022 *Paving The Way to Economic Success*



Industrial Waste Management

Environmental Business Opportunity



Objectives

To seek local environmentally acceptable and cost-effective solutions that:

- Meet national waste management regulations
- Minimize environmental and health risks
- Recover value from waste



Opportunities

THE WASTE HIERARCHY

Preferred Environmental Option



Least Preferred Environmental Option

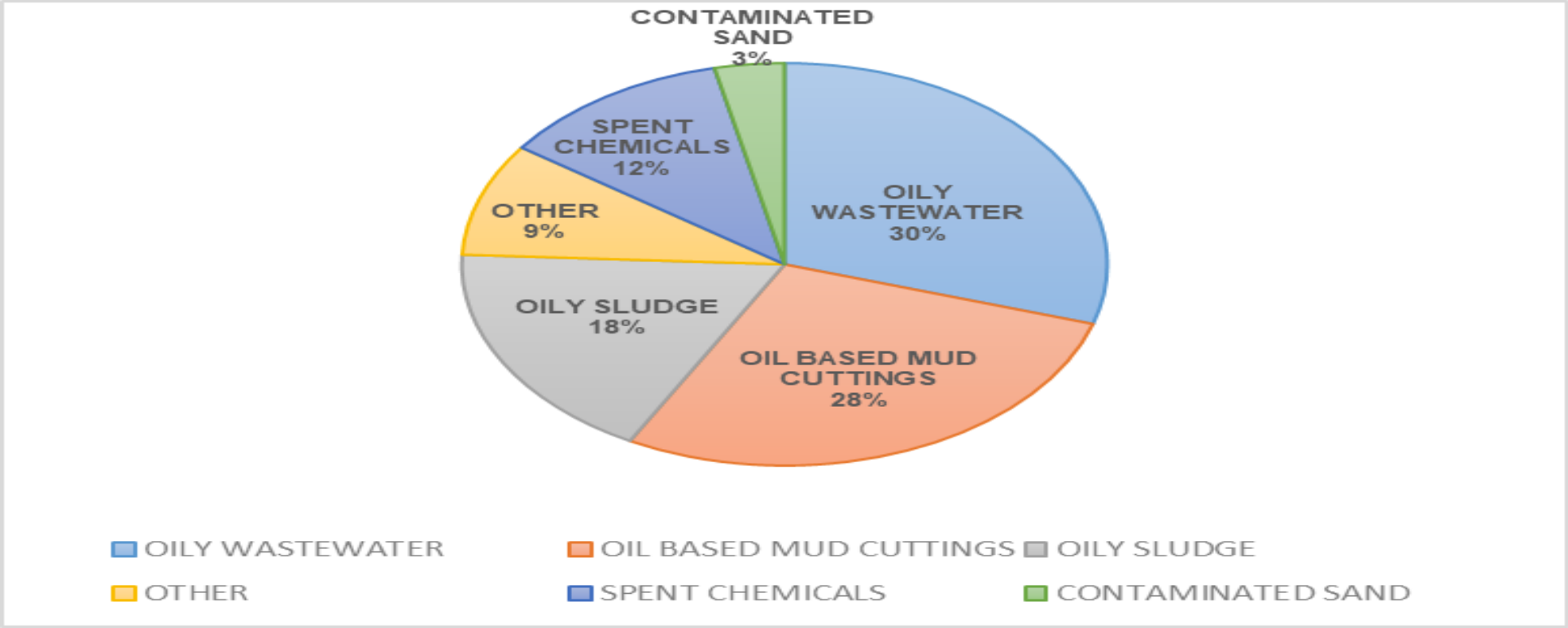
Industrial Waste Management

Environmental



2020 Saudi Aramco Generated Industrial Waste Breakdown

Environmental



Waste Management Infrastructure

Environmental



Recycle/Recover
mercury waste



Recycle/Recover
drilling waste



Recycle/Recover spent
desiccants/adsorbents



C&D waste recycling

Mobile Waste Management Technologies

Environmental



Automatic Hydrocarbon
Tank Cleaning



Recover Hydrocarbons from
spills and process vessels



Portable Industrial Waste
Analyzers



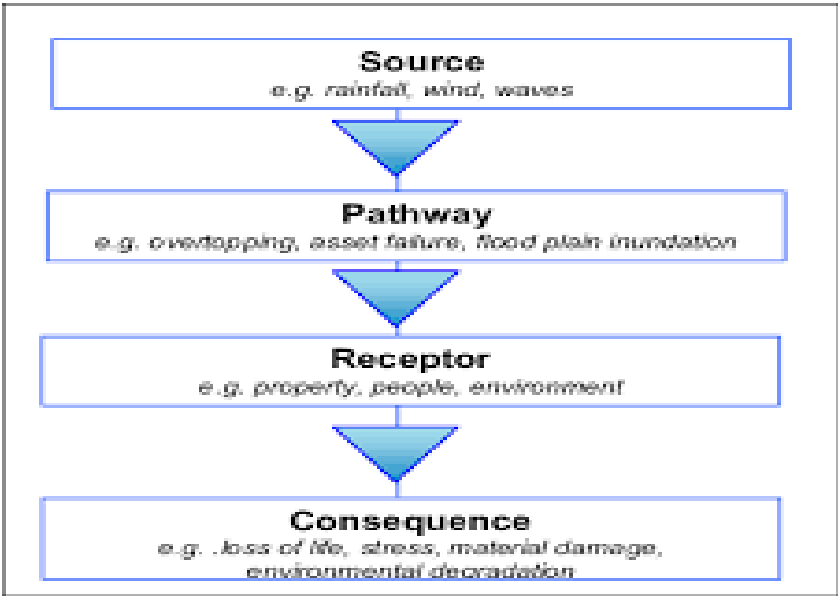
Onsite treatment of waste

Special Waste Management Studies

Environmental



Industrial Waste minimization
assessment



Contaminated Site
Characterization and Risk
Assessment



Industrial Waste
characterization

iktva 2022 *Paving The Way to Economic Success*



Radiation Protection Services

Environmental Business Opportunity



The Opportunity

The provision of a range of radiation protection support services, including:

- Radiometric Analysis
- Radiation Dosimetry Services
- Radiation Detector Calibration and Repair
- Radiation Survey
- Radiation Training



The Business Case

1. Currently limited availability
2. Growing requirement due to:
 - Increased use of radiation-based technologies
 - Impact of NORM
 - Implementation of nuclear power
 - Increased regulatory requirement

Radiometric Analysis



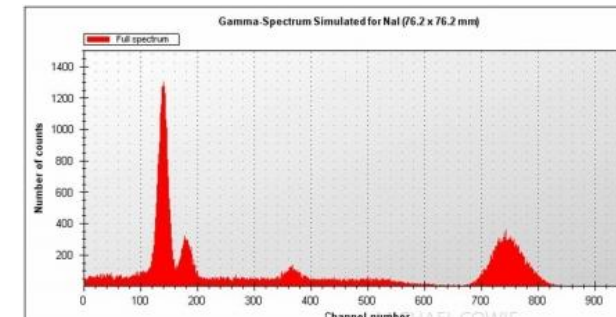
Main Function

Provision of qualitative and quantitative information on the presence of radioactivity. Required for disposal of waste, worker protection and environmental controls



Technical Specification

- Total Alpha determination
- Total Beta determination
- Gamma Spectrometry
- Liquid Scintillation counting



Radiation Protection Services

Environmental

Radiation Dosimetry Services



Main Function

To determine radiation exposure of workers, this is a legal requirement.



Technical Specification

Provision of government approved and permitted service for:

- External Dosimetry
- Internal Dosimetry*

* No current requirement within Saudi Aramco at moment, but may be required if Kingdom expands further into nuclear power.



Radiation Detector Calibration and Repair



Main Function

Radiation detectors must be calibrated every 12 months to ensure they are functioning correctly.

Repair and replace components to ensure satisfactory performance of radiation detectors.



Technical Specification

Ability to accurately assess the response of radiation detectors in compliance with international standards and government requirements.

- *IAEA Safety Report No16*
- *The Examination, Testing and Calibration of Portable Radiation Protection Instruments – Measurements and Good Practice Guide, produced by the National Physical Laboratory*



Required for:

- Alpha/Beta contamination detectors
- Gamma radiation detectors
- Neutron radiation detectors

Radiation Protection Services

Environmental

Radiation Survey



Main Function

The measurement and assessment of ionizing radiation and contamination levels associated with man-made sources and NORM impacted operations.



Technical Specification

- Alpha contamination levels (fixed and loose)
- Beta contamination levels (fixed and loose)
- Gamma radiation dose-rates
- Neutron dose-rates



Radiation Protection Services

Environmental

Radiation Training Services



Main Function

Provision of radiation training to support operations where ionizing radiation sources are used or operations are impacted with NORM.



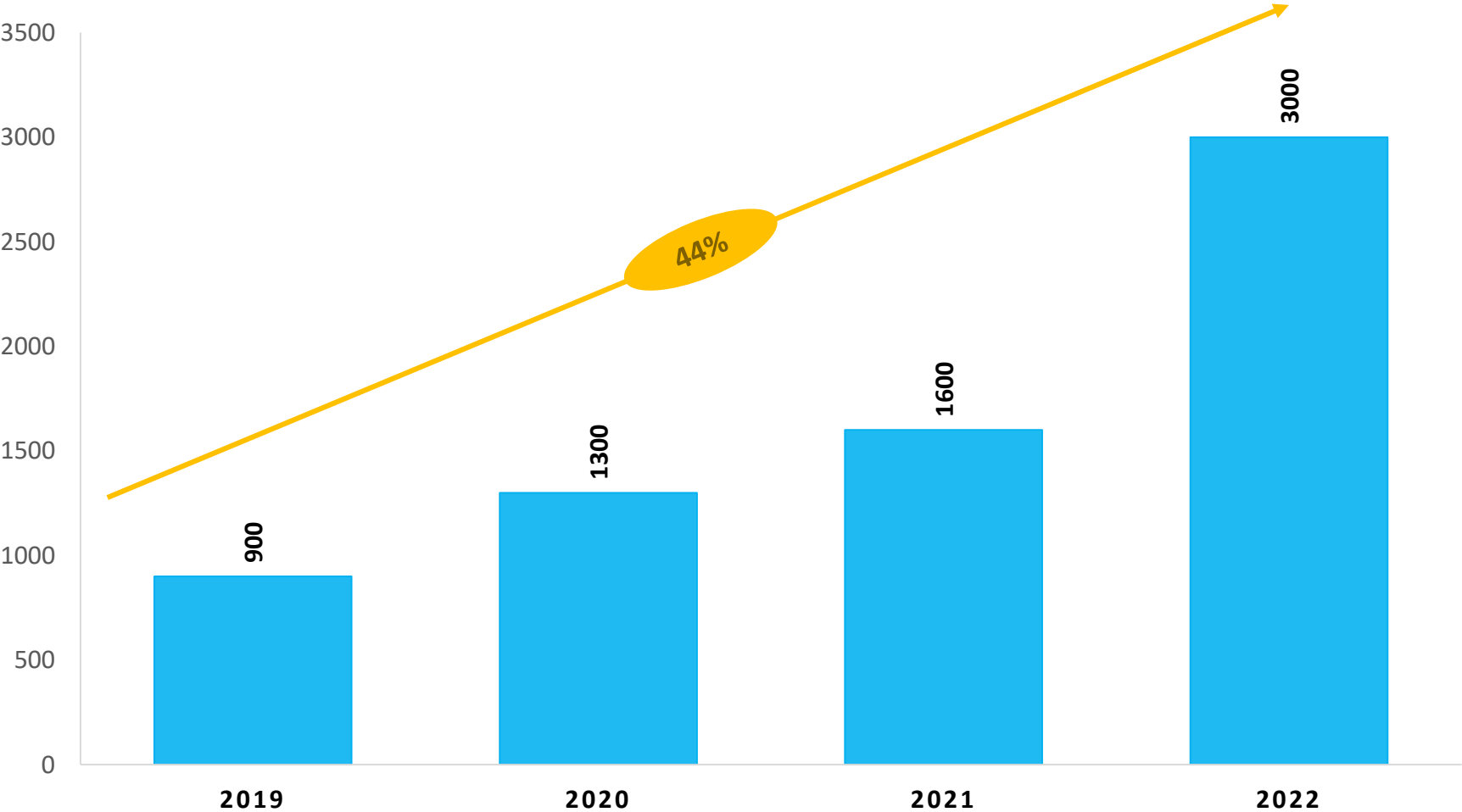
Technical Specification

- Radiation Protection for Industrial Radiography
- Radiation Protection for NORM workers
- Radiation Protection Officer Certification Preparation
- Transport of Radioactive Material
- Radiation Protection for Rig Foremen
- Radiation Protection for Nuclear Gauge Operators



Saudi Aramco Radioactive Source Inventory

Environmental

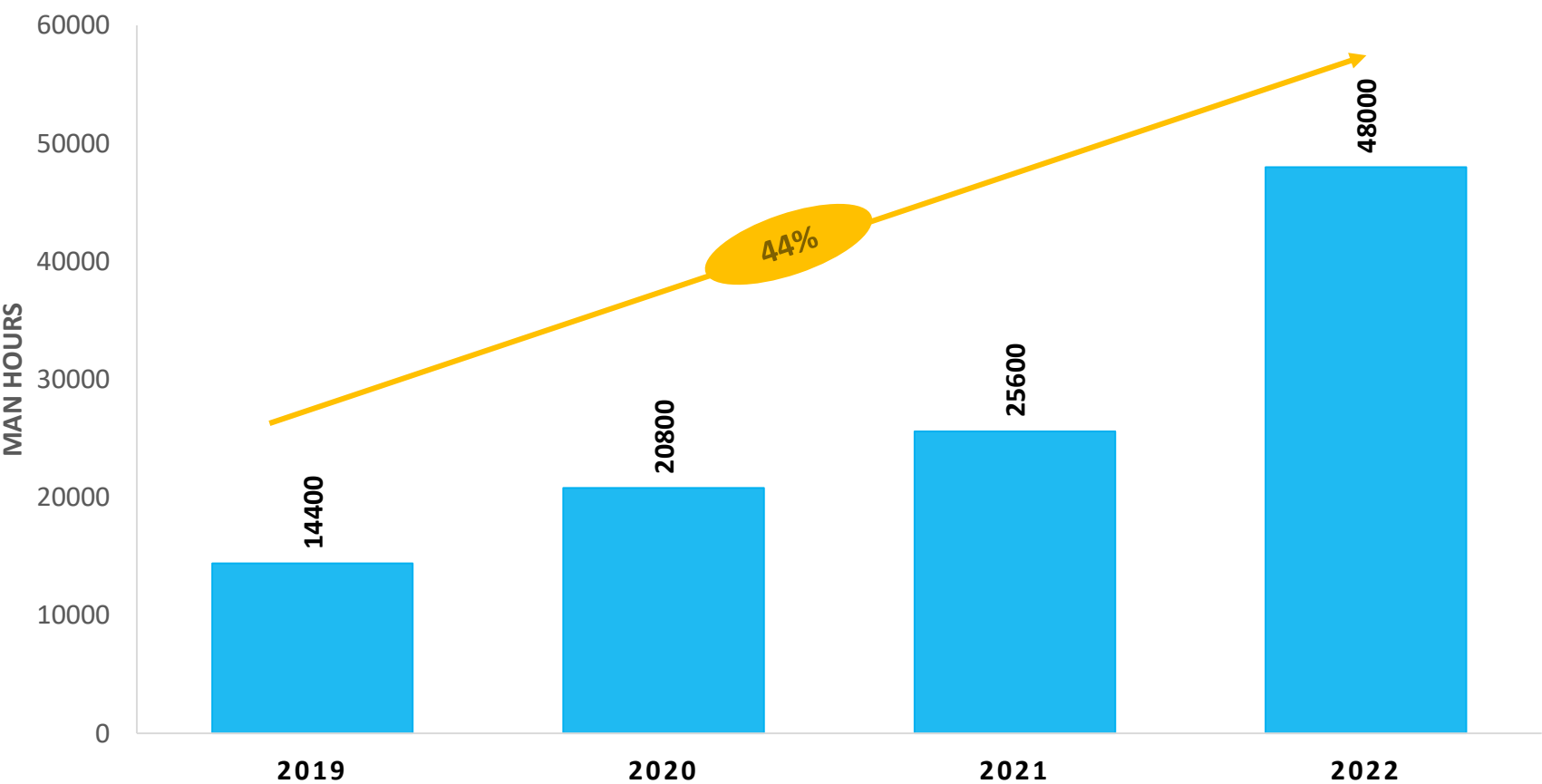


- There is a significant increase in the use of radioactive material in Saudi Aramco operations.
- This inventory requires services to ensure the safety of workers, the security of sources and compliance with Government requirements.

Anticipated Support Services Requirements

Environmental

Minimum Workload To Support Radioactive Source Inventory



- The minimum activities to ensure compliance with corporate standards.
- Licensing, administration, certification, training, monitoring, and calibration

Naturally Occurring Radioactive Material (NORM) Disposal

Environmental Business Opportunity



The Opportunity

Saudi Aramco's operations and that of others in KSA produce NORM waste. This waste must be disposed in a controlled manner in a government approved disposal facility.

Saudi Aramco seeks disposal routes or technologies to dispose of its NORM waste.



The Business Case

1. Current inventory around 10000m³
2. Anticipated to increase annually as water-cut increases
3. Other NORM waste producers:
 - Water-treatment
 - Mining
 - Phosphate

Naturally Occurring Radioactive Material (NORM) Disposal

Environmental

NORM Disposal



Main Function

Risk and cost analysis already identified:

- Underground Injection
- Class One Landfill



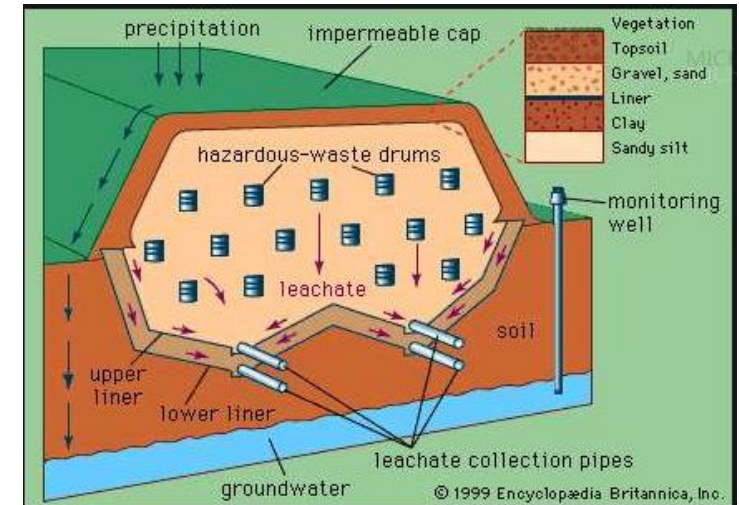
Technical Specification

Pre-treatment to ensure suitable for disposal option/s:

- Physical, chemical, biological, and thermal

Systems in place for:

- Collection/transportation, processing, disposal, monitoring, compliance, and licensing



NORM Activity Concentrations

Environmental

Worldwide reported levels of NORM

Nuclide	Specific Activity (Bq/g)		
	Scale	Sludge	Scrapings
Ra-226	0.1 to 15000	0.05 to 800	0.01 to 75
Pb-210	0.02 to 75	0.1 to 1300	0.06 to 50
Po-210	0.02 to 1.52	0.003 to 160	0.1 to 4

Currently, Saudi Aramco NORM waste is at the lower end, but is anticipated to rise.

Saudi Aramco NORM Waste Exemption Levels

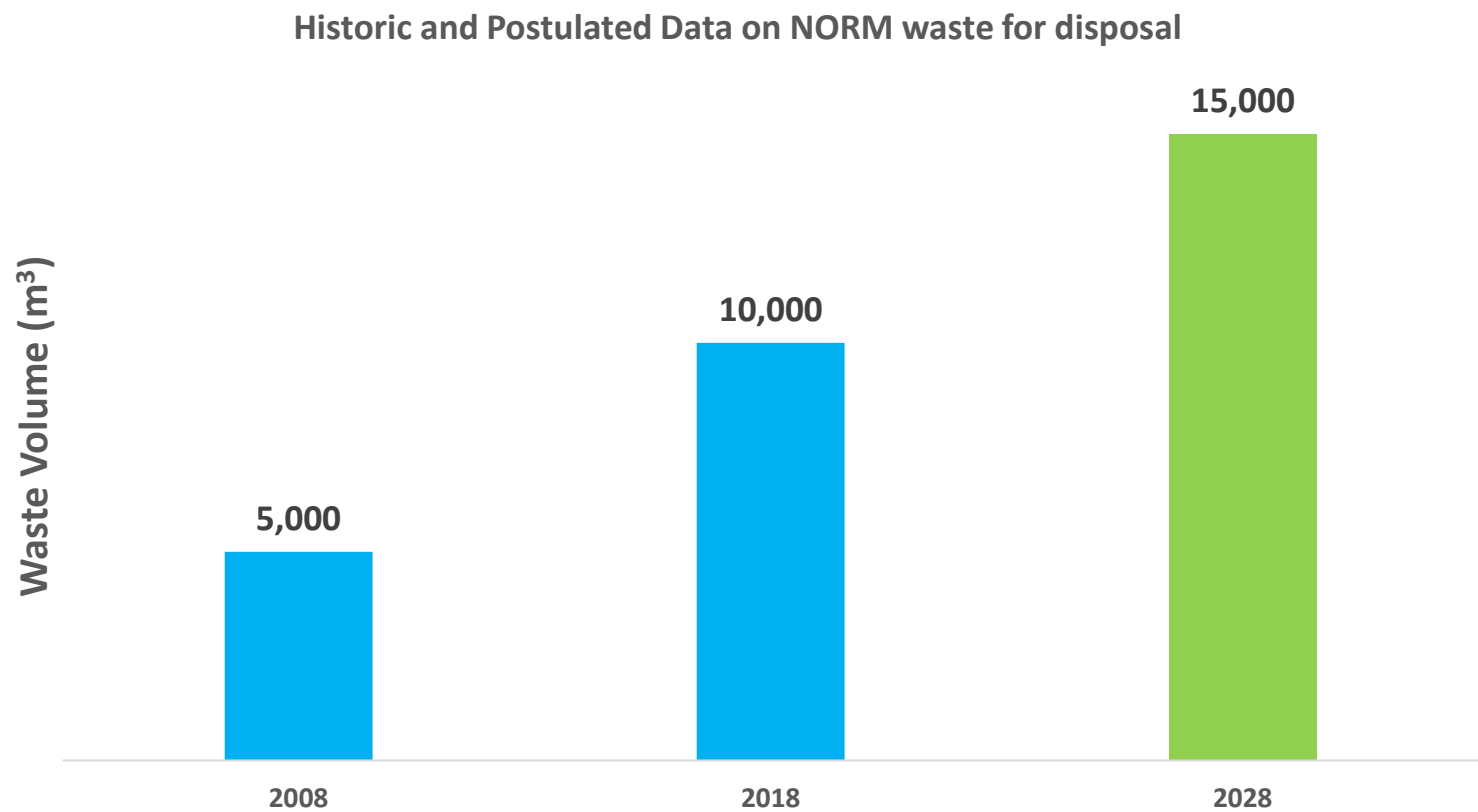
Environmental

Radionuclide	Exemption Level (Bq/g)	Exemption Level (pCi/g)
Ra-226	1.1	30
Ra-228	1.1	30
Pb-210	0.2	5
Po-210	0.2	5
U-238	5.5	150
Uranium (Nat)	3.0	80

Waste at or below these levels can be disposed of without radiological control.

Saudi Aramco NORM waste inventory

Environmental



5000m³ of waste per decade.
Increase also anticipated with
increased water cut.

Naturally Occurring Radioactive Material (NORM) Decontamination

Environmental Business Opportunity



The Opportunity

Saudi Aramco's operations and that of others in KSA generate NORM Oil Country Tubular Goods (OCTG) and other related materials that require decontamination.

Saudi Aramco seeks decontamination routes or technologies to decontaminate its NORM OCTGs and related materials.



The Business Case

1. Current there are 12,800 NORM OCTG stacked in Reclamation yard.
2. Average of 2,900 NORM OCTG received annually.
3. Anticipated to increase annually as operations are increasing.

Naturally Occurring Radioactive Material (NORM) Decontamination

Environmental

NORM Decontamination



Main Function

Equipment required:

- High Pressure Water Jetting Pump.
- Water Filtration System
- Water Recycling System
- Hazardous Dust Vacuum Cleaner (Type H).
- Full Personal Protective Equipment (PPE).



Technical Specification

OCTG Decontamination:

- Internal & External.
- Pump pressure (12,000- 15,000 PSI).

Land is in place for:

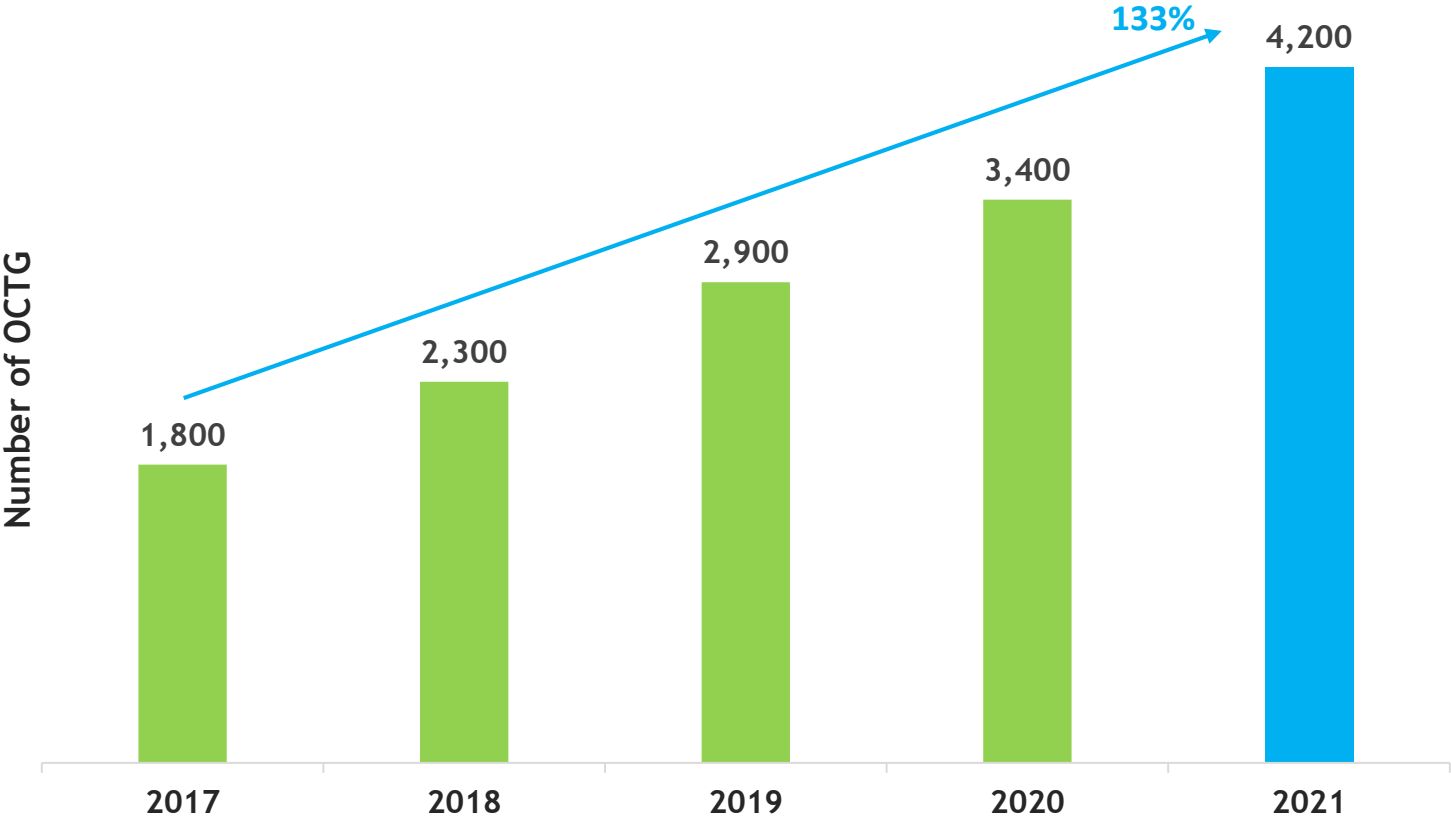
- Mobilization, operations and temporary offices.



Saudi Aramco NORM OCTG inventory

Environmental

Historic Data on NORM OCTG for decontamination



Average of ~2,900 annually requires NORM decontamination.

In addition to current backlogged total of 12,800 OCTG.

Consumed Chemicals and Lubricant Oil (Reuse/Recycle)

Environmental Business Opportunity



The Opportunity

Saudi Aramco's operations and that of others in KSA generate high volume of consumed chemicals and lubricant oil.

Saudi Aramco seeks re-use/recycle routes or technologies to re-use/recycle its generated consumed chemicals and lubricant oil.



The Business Case

1. Current backlogged inventory around 2M US Gallons.
2. Average of 510K US Gallon annually.
3. Anticipated to increase annually as operations are increasing.

Consumed Chemicals and Lubricant Oil Reuse/Recycle

Environmental



Requirements

- Government authorization to reuse/recycle Chemicals/Lubricant Oil.
- National Center for Environmental Compliance License.
- Commercial Registration include Chemicals / Lubricant Oil.
- Re-use/Recycle Process plan.



Technical Specification

Types of Chemicals:

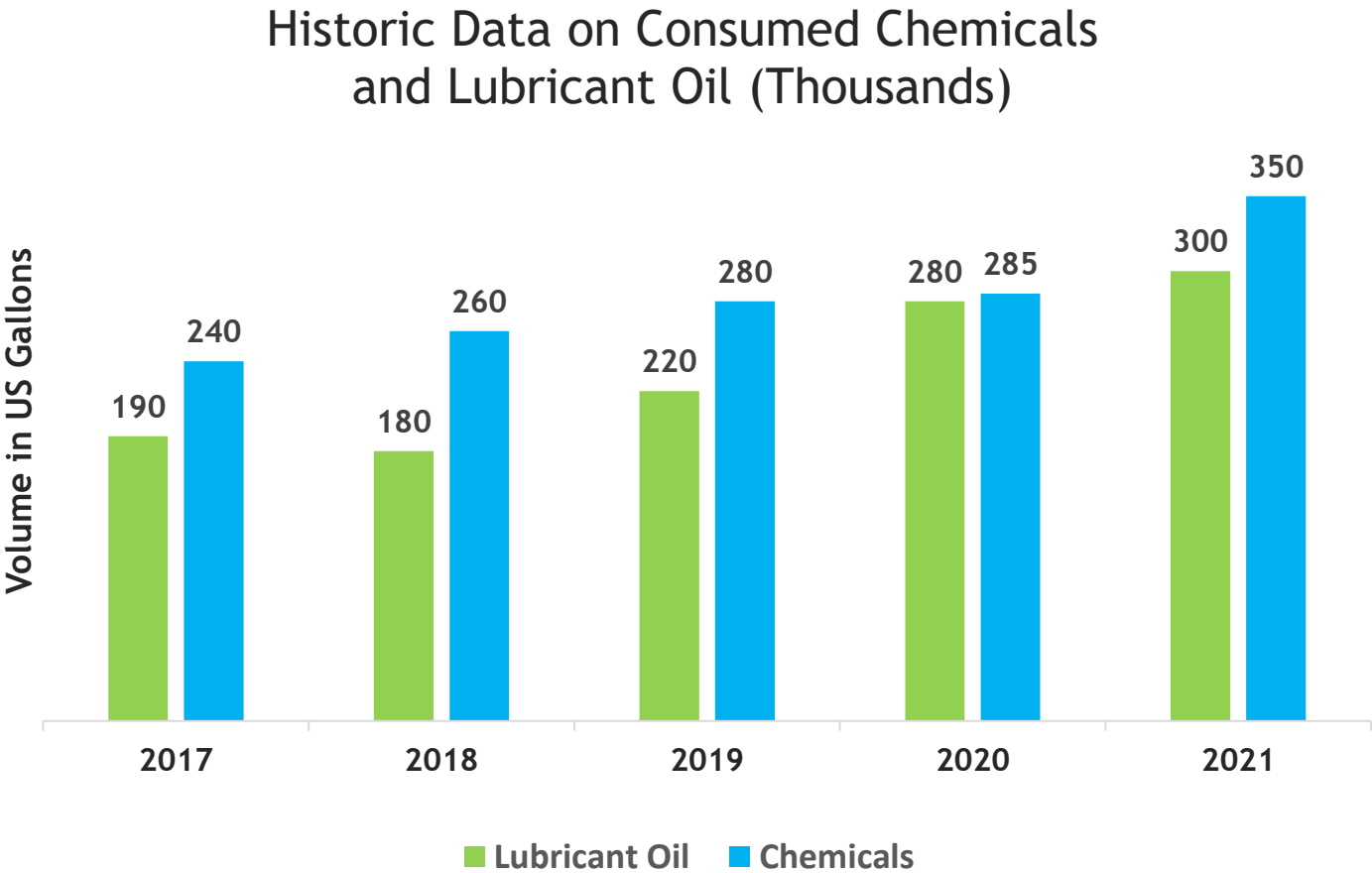
- Acids.
- Solvents.
- Refractories.
- Halogenated.
- Lab Reagents.
- Glycol Amines.

Types of Lubricant Oil:

- Engine Oil.
- Turbine Oil.
- Transmission Oil.
- Transformer Oil.

Consumed Chemicals and Lubricant Oil Record

Environmental



Annual average of ~230K US Gallons of lubricant oil, and ~280K US Gallons of Hydrocarbon Chemicals

In addition to current backlogged inventory of 2M US Gallons.

Expired/Used Batteries (Re-use/Recycle)

Environmental Business Opportunity



The Opportunity

Saudi Aramco's operations and that of others in KSA generate huge volume of expired/used Batteries.

Saudi Aramco seeks re-use/recycle routes or technologies to re-use/recycle its generated expired/used Batteries.



The Business Case

1. Average of $\approx 9,100$ unit annually.
2. Anticipated to increase annually as operations are increasing.

Expired/Used Batteries Reuse/Recycle

Environmental



Main Function

Requirements:

- Government authorization to reuse/recycle Batteries.
- Commercial Registration include Batteries business.
- Process plan.



Technical Specification

Types of Batteries:

- Acid based Batteries.
- Lead cadmium and copper Batteries.

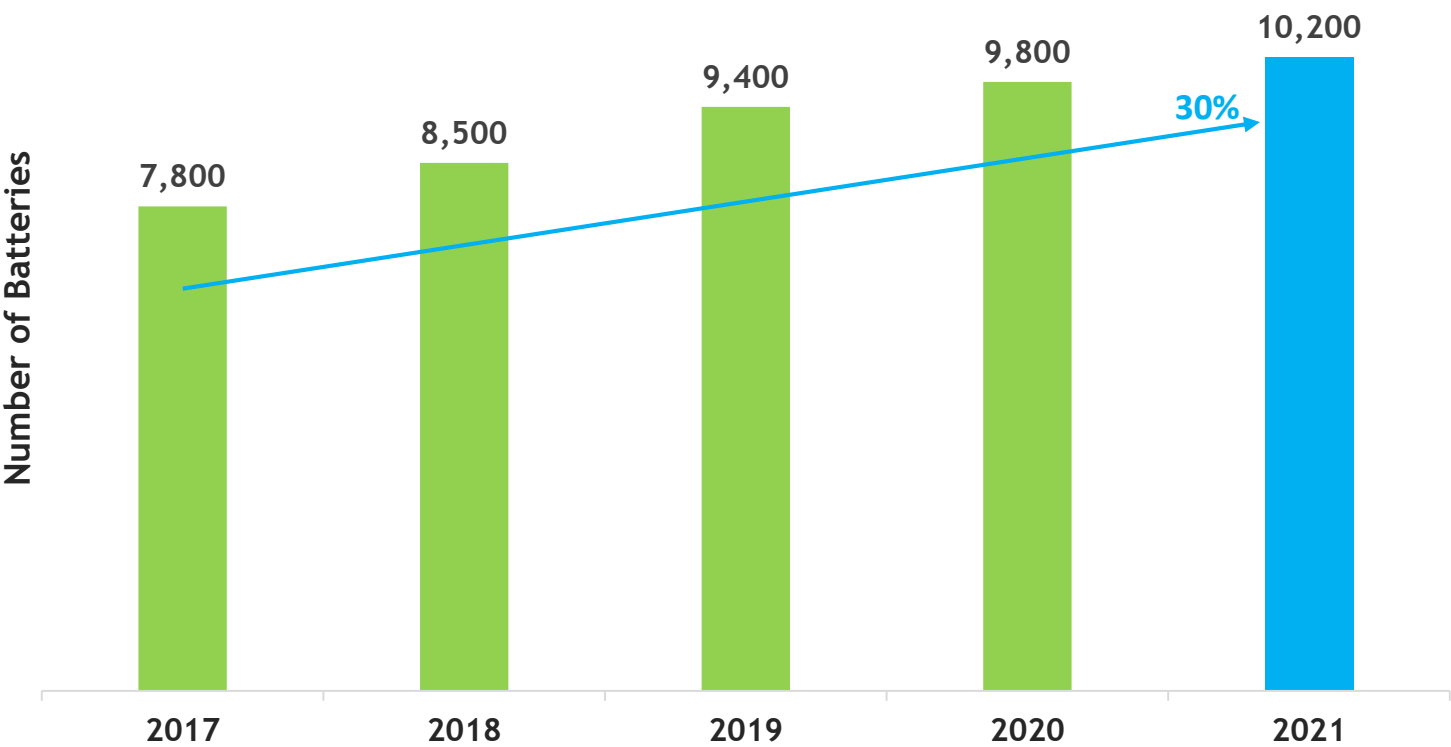
Batteries Usage:

- Engine/Pump Batteries.
- Car/Truck Batteries.
- Solar Batteries
- Fire system Batteries.

Expired/Used Batteries Record

Environmental

Historic Data on Expired/Used Batteries



Average of ~9,100 annually expired/used Batteries.

iktva 2022 *Paving The Way to Economic Success*



Environmental Health Services

Environmental Business Opportunity



The Opportunity

The provision of a range of environmental health support services, including but not limited to:

- Contractor Camp Environmental Health Inspections
- Food sampling analysis
- Water sampling analysis
- Contractor Wellbeing Services



The Business Case

1. Currently limited availability of competent qualified personnel

Growing requirement due to:

Increased project scopes across the company

Contractor wellbeing and public health impacts relating to communal contractor camp living

Public health impacts relating to food safety

Public health impacts relating to water safety

Contractor Camp Inspection, Food and Water Analysis

Environmental



Main Function

Provision of contractor wellbeing services in addition to qualitative & quantitative information relating to public health impacts at communal contractor camp sites, spread of communicable disease & food and water sampling/analysis.

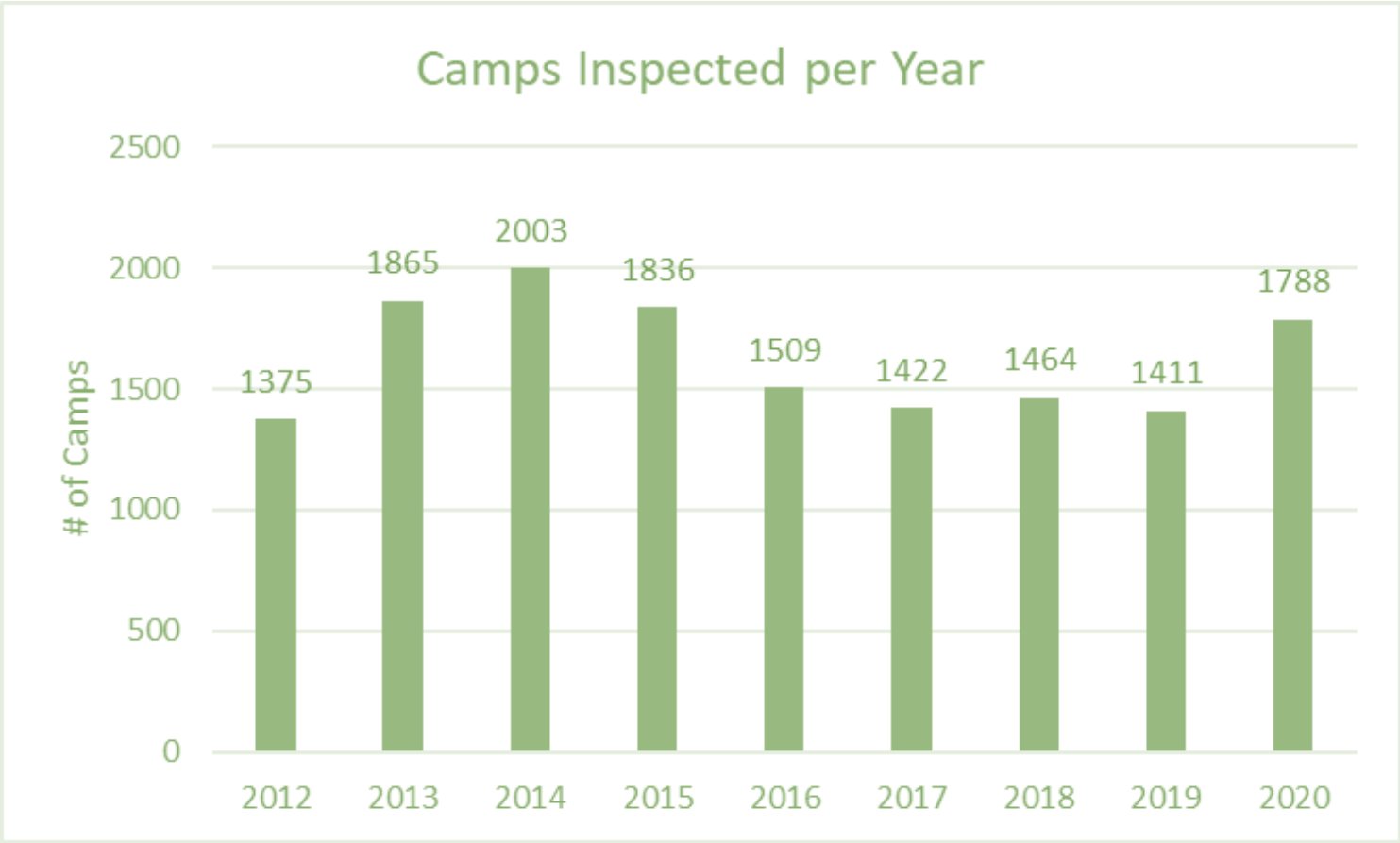


Technical Specification

- Contractor Wellbeing services
- Contractor camp public health inspection
- Communicable disease control at camp facilities
- Food microbiology analysis
- Water microbiology analysis

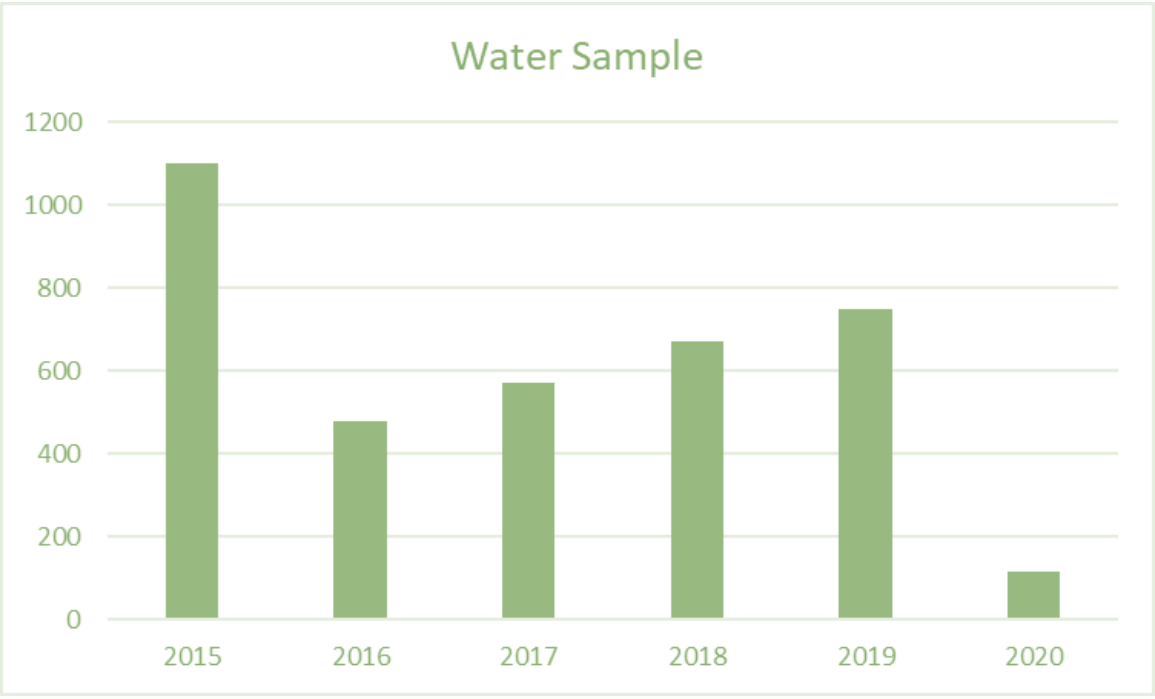
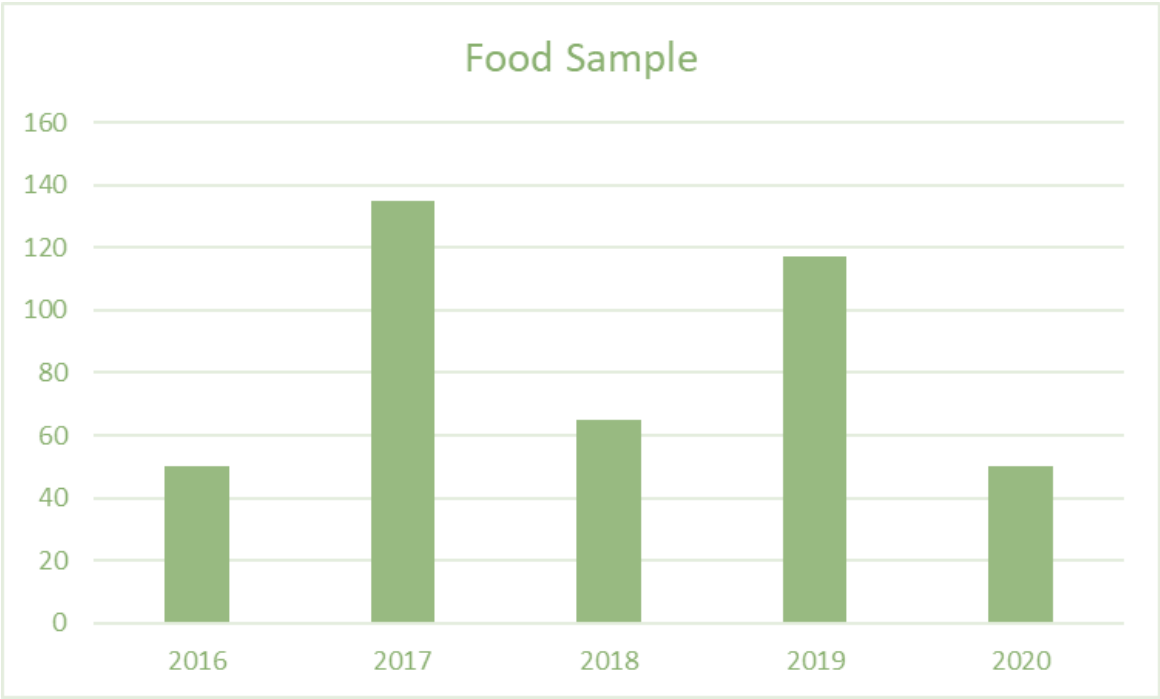
Contractor Camp Inspection Demand

Environmental



Food and Water Analysis Demand

Environmental



Contractor Camp Inspection, Food and Water Analysis Man Hours

Environmental

CCEHI Man Hours

EP conducts in excess of 1400 CCEHI inspections per year. Each inspection takes four hours on average, including inspection and administration.

These figures are expected to increase with the start up of numerous mega-projects across the Kingdom. Therefore, a significant increase in camp numbers is expected.

Food and Water Laboratory Services

- EP conducts and submits approximately 120 food and 800 water samples respectively per year for microbiological analysis.
- Each sample takes approximately two hours, including sample and administration, plus additional time for the sample to be analyzed and interpreted.

Contractor Wellbeing

- EP provides contractor wellbeing services to over 300,000 contractor employees, including provision of a 24/7 hotline, online wellbeing platform and onsite wellbeing assessment services.
- There are approximately 24,000 wellbeing appointment slots for one-to-one counselling, requiring 18 psychologists. In addition, wellbeing assessments are carried out for 10% of the contractor population annually.

iktva 2022 *Paving The Way to Economic Success*



Industrial Hygiene Services

Environmental Business Opportunity



The Opportunity

The provision of a range of Industrial Hygiene (IH) support services, including:

- Exposure sampling and monitoring analysis
- IH equipment calibration and maintenance
- Asbestos services (identification, removal and proper disposal)
- IH specific assessment and consultation
- IH technical training services



The Business Case

1. Currently limited availability
2. Growing requirement due to:
 - Increased demand for IH consultation services
 - Impact of governmental regulations' new requirement on occupational health
 - Increased numbers of new different natures and facilities

IH Sampling Analysis

Environmental



Main Function

Provision of quantitative analysis of IH samples. Required for workers' protection and environmental controls.



Technical Specification

Historically spent from \$80K to \$100K annually from one service provider. Laboratory acquire sampling media from big companies such as SKC, 3M, ASSA technology, and SEGMA. Some service providers have facilities within the region, however, some samples are shipped overseas (to e.g. USA) for analysis that require certain lab accreditation such as AIHA. Top uses of sampling in our regular assessments are BTEX, H₂S, SO₂, welding fumes, and Hg.



IH Equipment Rental, Calibration and Maintenance

Environmental



Main Function

IH equipment are used in occupational health assessments. Equipment, including noise, IAQ, personal sampling air pumps, heat stress, ventilation and others, must be serviced and calibrated periodically. Most manufacturers require annual calibration. Frequent repair and component replacement are carried out to ensure reliable performance of IH equipment. The estimated equipment purchase cycle is every five years .



Technical Specification

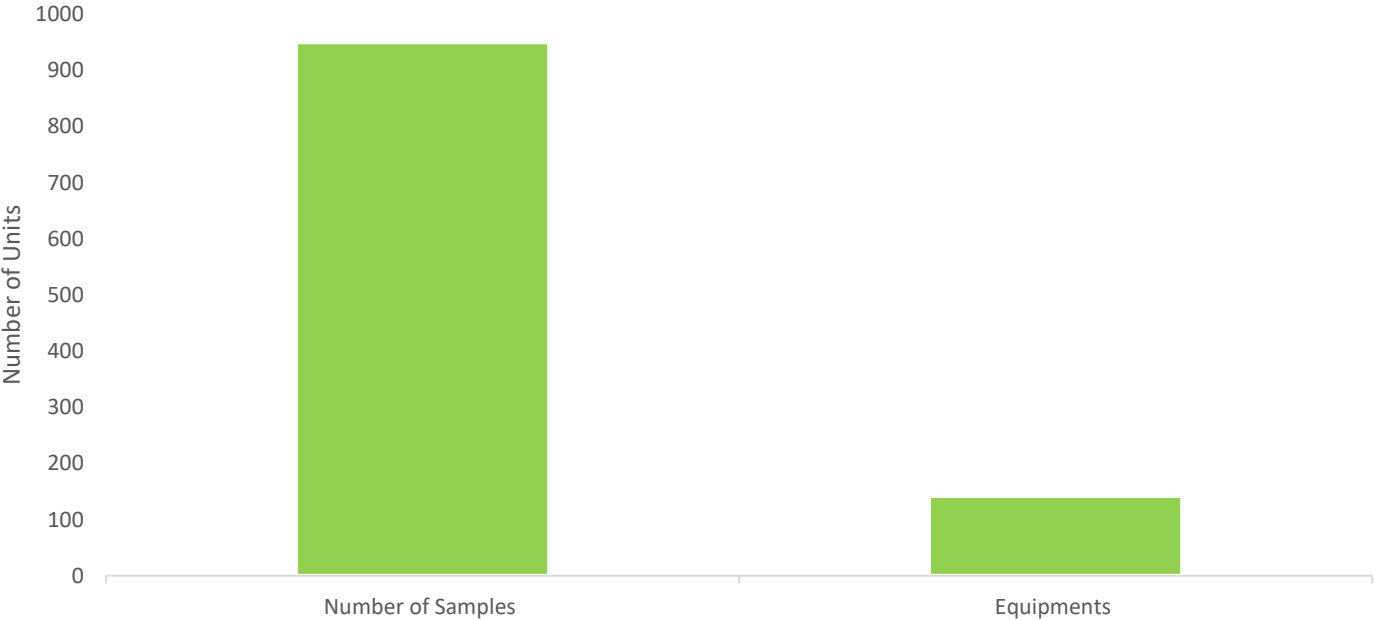
Provision of government approved and permitted service and instrument manufacturer's endorsement for: IH equipment rental, calibration and maintenance services. High dollar value equipment, such as FTIR, and GC, (cost around \$20K to \$30K). Calibration outside Saudi is frequent and annual calibration is a legal requirement. Equipment to be sent annually is around 80 - 100 pieces. Cutting turnaround time and shipping cost are goals.



IH Equipment and Sampling Analysis

Environmental

Forecast of Equipment & Sampling Analysis



- The minimum number of IH equipment and samples required for compliance with Corporate standards.
- Increase in required compliance assessments increases the utilization of IH equipment and sampling to ensure worker’s health protection and compliance.

Asbestos Services (Identification, Removal and Disposal)

Environmental



Main Function

Provision of qualitative and quantitative analysis of asbestos containing materials (ACMs).
Asbestos training, identification abatement, and proper disposal related activities

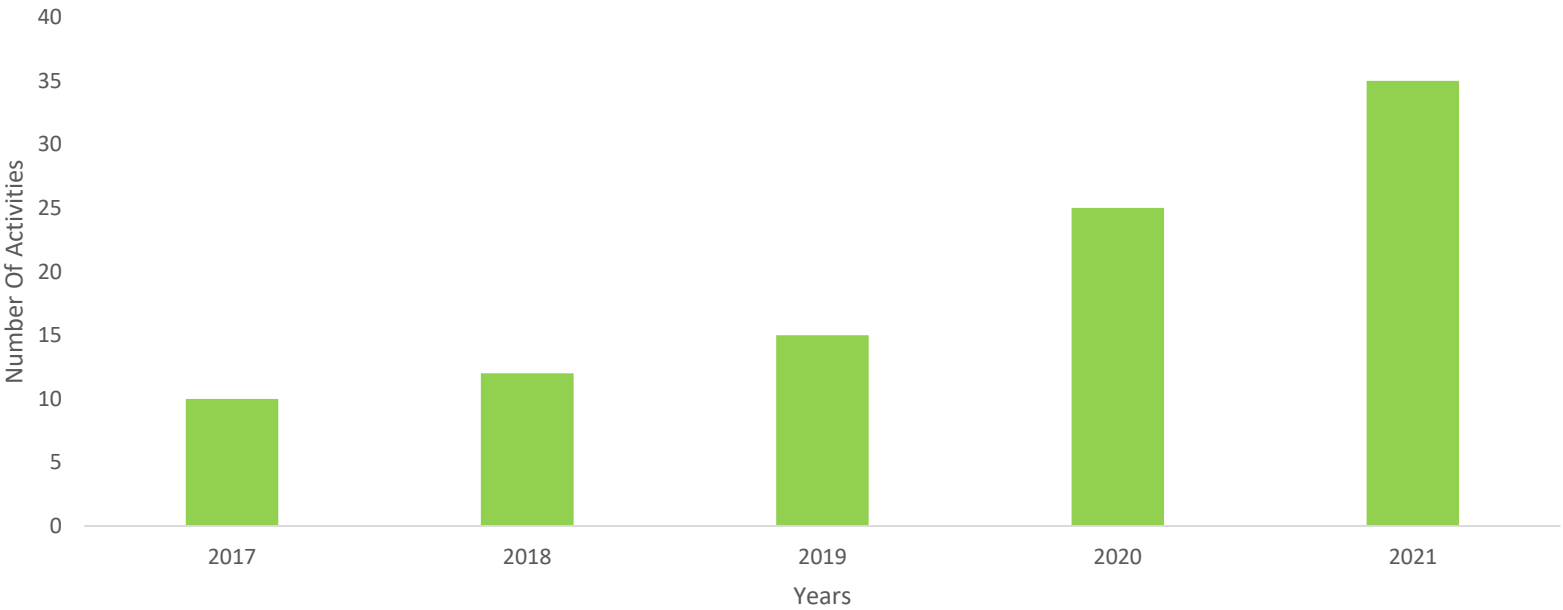


Technical Specification

Provision of government approved and permitted specialized services to perform asbestos works.
Availability of required equipment
Ability to accurately assess ACMs
Qualification and accreditation
Certified calibrated equipment
Ability to provide training
The local market is still scarce for asbestos related services



Asbestos Related Activities



- Robust asbestos activities are required to ensure compliance with the Company standards and governmental regulations
- Increased enforcement of government and the Company standards increases the workload to ensure worker’s protection and compliance against asbestos health hazards.

IH Specific Assessment and Consultation

Environmental



Main Function

The qualitative and quantitative assessment of occupational health hazard levels associated with work environments.



Technical Specification

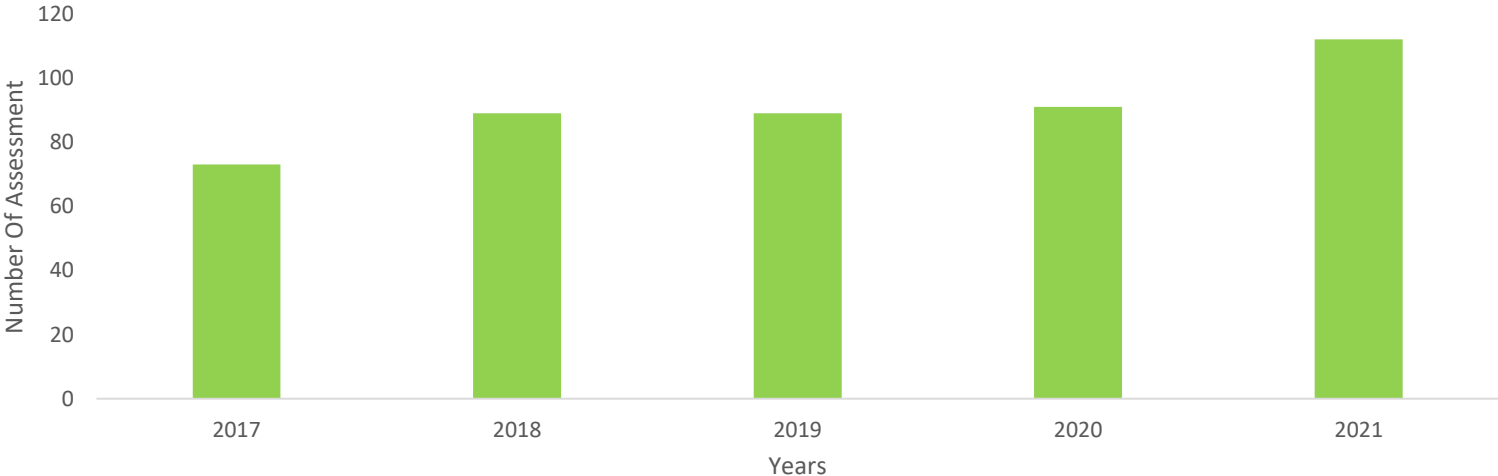
Assess chemical, physical, biological, ergonomic and other health hazards.



IH Specific Assessment and Consultation

Environmental

Industrial Hygiene Specific Assessment and Consultation



- The number of specific assessment activities have increased with the increased number of facilities and operations.
- Increase in required standard compliance has increased the assessments workload to ensure worker’s health protection.

IH Specific Training Services

Environmental



Main Function

Provision of specific IH training to support the workforce where occupational health hazard sources are present



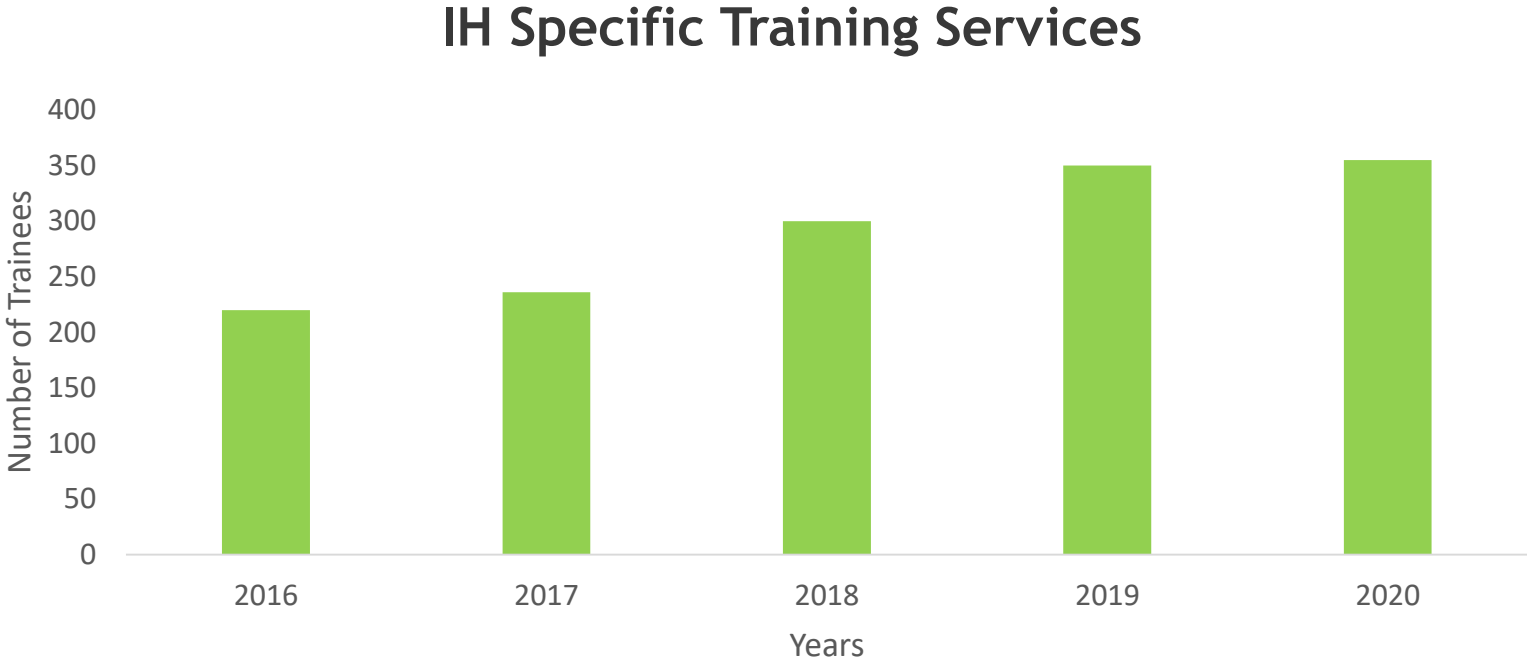
Technical Specification

- IH assessment training for noise level, chemical exposure, ergonomics, ventilation, and Hazardous Material Communication (HazCom)
- Professional certification Preparation (e.g., certified industrial hygienist or others)



IH Specific Training Services

Environmental



- The number of workers requiring IH training related services is increasing
- Increased workers’ protection and compliance required increase in providing specific IH training

iktva 2022 *Paving The Way to Economic Success*



Water and Wastewater Treatment

Environmental Business Opportunity



The Opportunity

Address the current and future water and wastewater systems by assemble, manufacture, operate, maintain and deploy cost-effective, state-of-the-art technologies for water and wastewater systems



The Business Case

The business driver is to operate and maintain Saudi Aramco Water and Wastewater Treatment facilities to meet Saudi Aramco commitments to the Environmental Policy Statement, Saudi Government regulations and international commitments.

Water and Wastewater Treatment

Environmental



Water Treatment Systems

Environmental

1. Ion Exchange systems

2. Membrane desalination systems

Ion-Exchange Systems

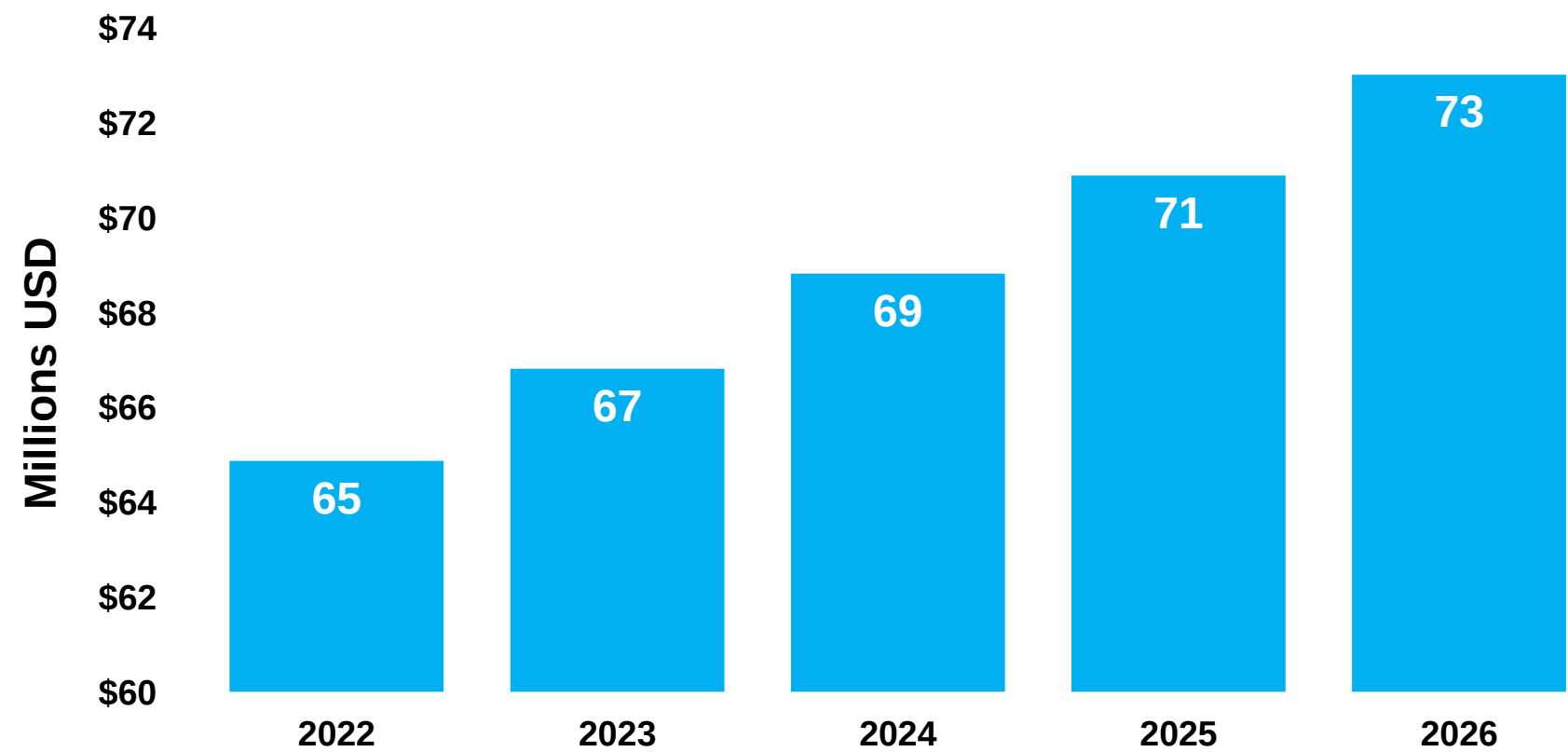
Environmental

- Ion Exchange systems and resins for water purification
 - Mixed-bed and separate-bed configurations
- ☐ Application:
- Production of boiler feedwater makeup
 - Steam condensate polishing systems
 - Water softening systems for cooling towers makeup



Ion-Exchange Systems Forecasted Spend

Environmental



• Total forecasted spend on Ion Exchange systems for the next five years is \$344.6MM (2022-2026)

Membrane Desalination Systems

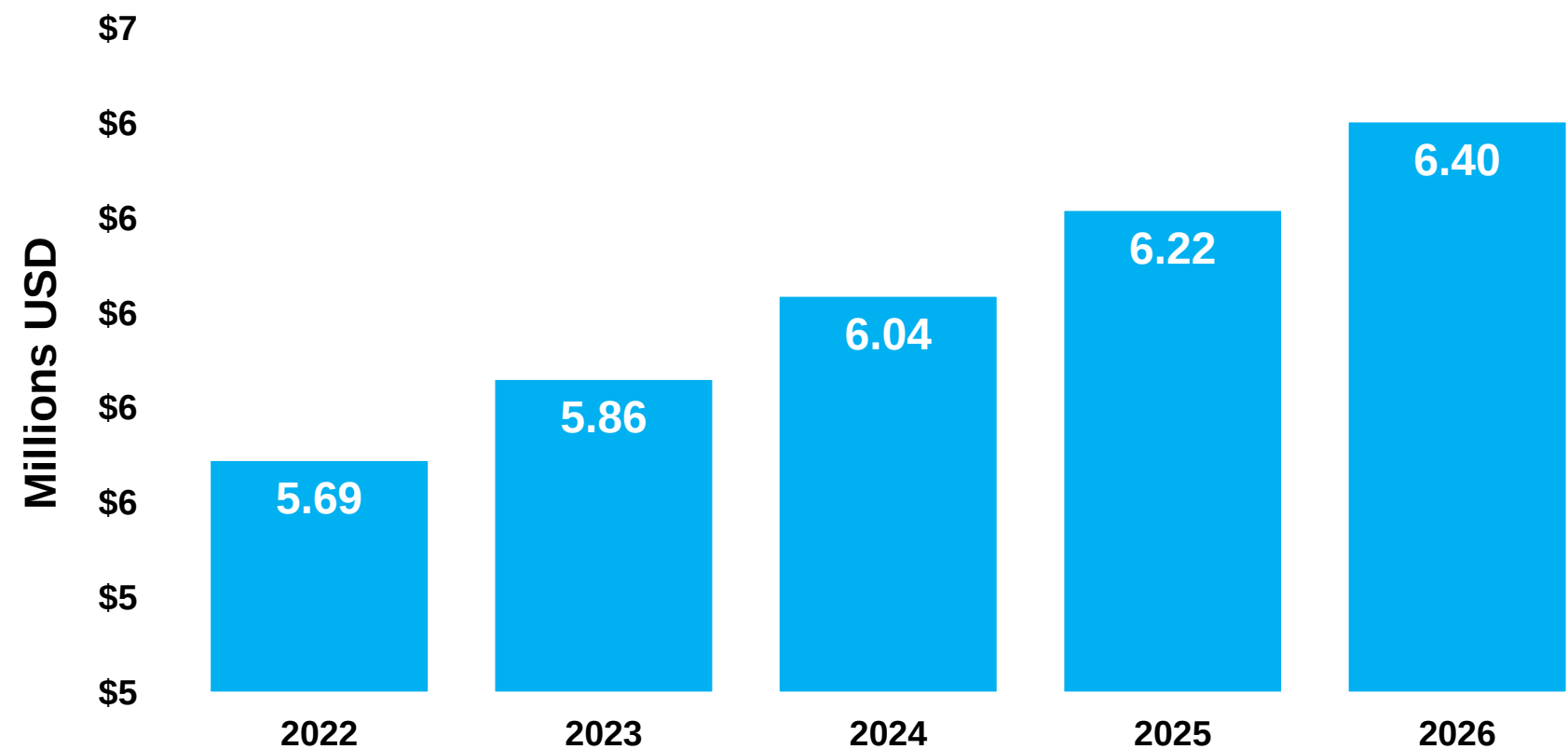
Environmental

- Reverse osmosis and nanofiltration
- For the production of utility water, demineralized water and softened water
- Including pre-treatment, chemical injection and post-treatment.



Membrane Desalination Systems Forecasted Spend

Environmental



• Total forecasted spend membrane desalination systems for the next 5 years is \$30.2MM (2022-2026)

Wastewater Treatment Systems

Environmental



1. Wastewater Package Treatment Plant

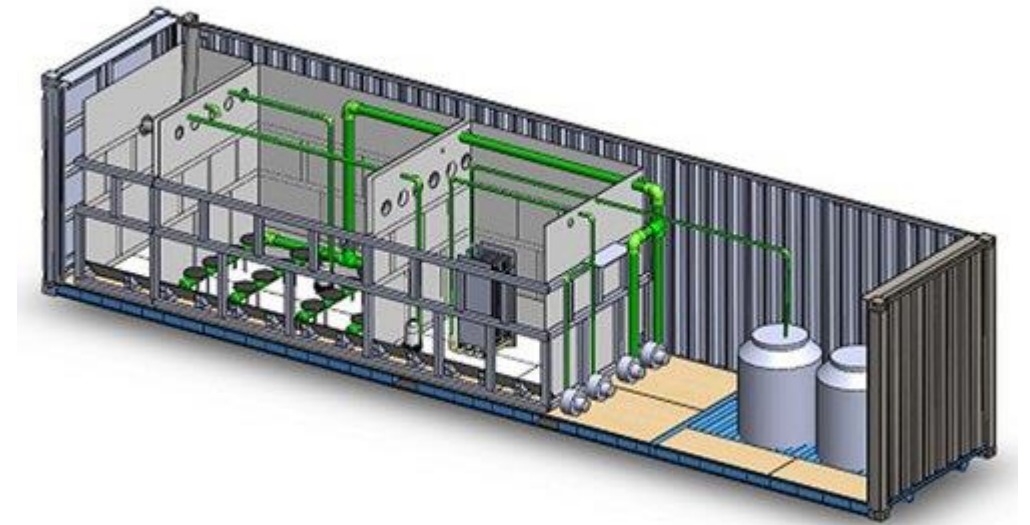


2. Oily Water Primary Separators

Wastewater Package Treatment Plant

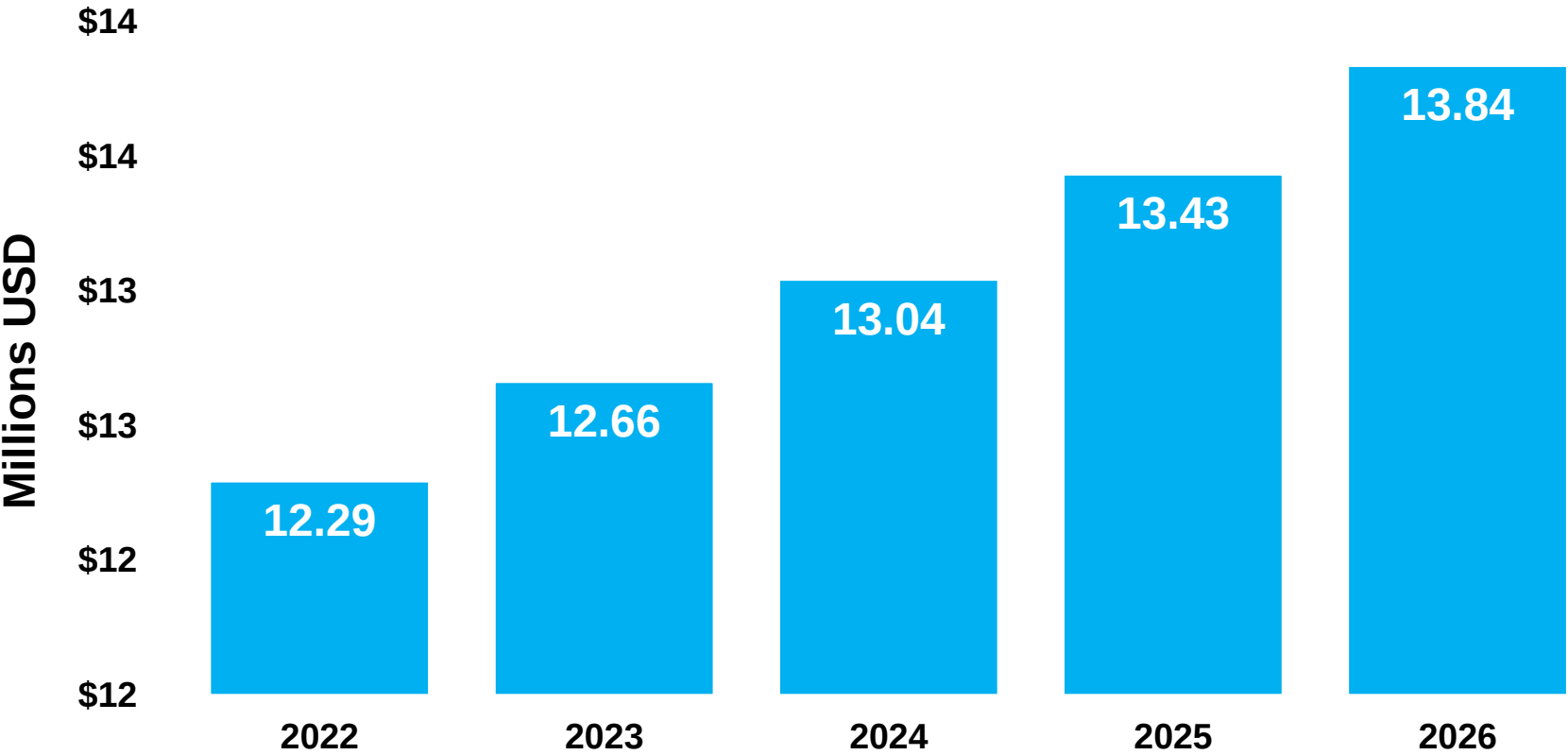
Environmental

- Prefabricated complete biological wastewater treatment system used to treat wastewater in small communities or remote areas



Wastewater Package Treatment Plant Forecasted Spend

Environmental

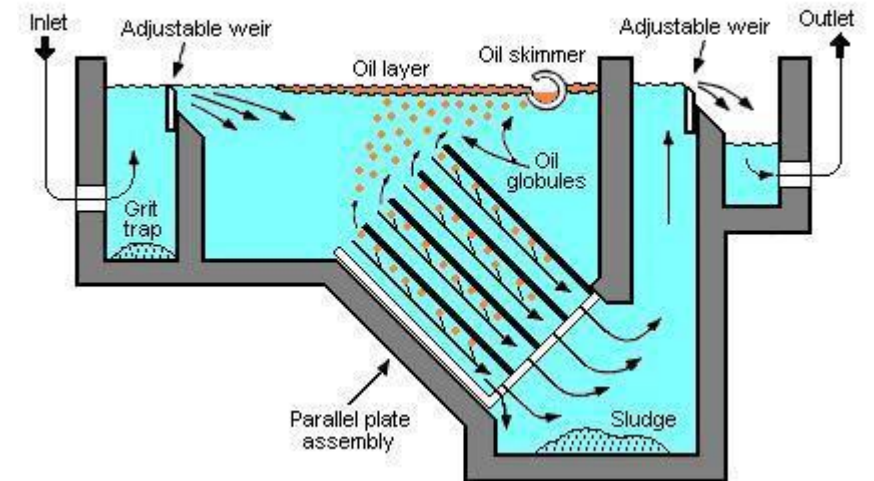
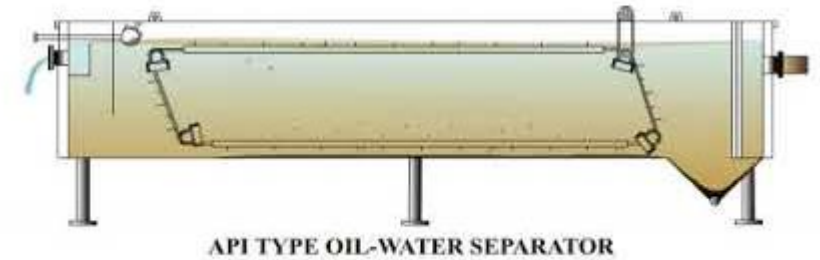


• Total forecasted spend on wastewater package treatment plants for the next five years \$65.3MM (2022-2026)

Oily Water Primary Separators

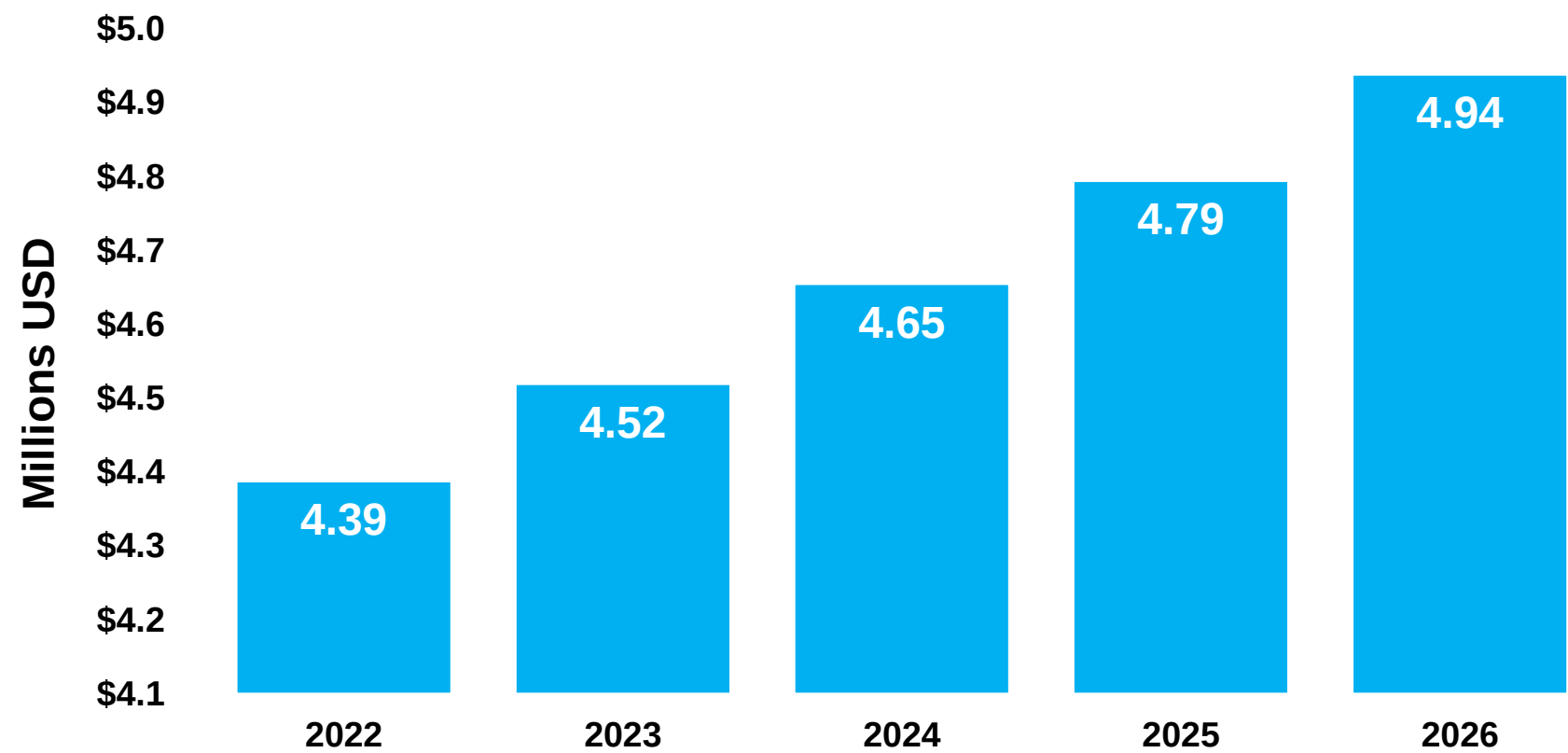
Environmental

- Oily water API separators:
Primary elevated rectangular tanks that separate free oil from water by gravity and separates oily sludge and solids from water by chain and flight scrapers.
- Oily water inclined plates interceptors:
Gravity separators inclined plates interceptors contain inclined plates pack for removing oil and suspended solids from oily wastewaters where the oily wastewater being treated contains very small concentrations of solids and oily sludge.



Oily Water Primary Separators Forecasted Spend

Environmental



- Total forecasted spend on oily water primary separators for the next five years is \$23.3MM (2022-2026)

Please direct all inquiries to:

In case you are interested in discussing these opportunities further, please contact:



Omar Saleh Alkerishan

Local Business Development

Saudi Aramco

omar.alkerishan@aramco.com



Abdullah M Al-Qahtani

Local Business Development

Saudi Aramco

abdullah.qahtani.69@aramco.com

aramco
iktva
local focus, global vision

For more business development and market information, please visit:

Website: www.iktva.sa/opportunities

Email: local-content@Aramco.com

