

Chemicals

Process Chemicals Workshop

Business Opportunities

14th January 2025

This presentation may contain certain forward-looking statements. All statements other than statements relating to historical facts are, or may be deemed to be, forward-looking statements. Forward-looking statements include, but are not limited to, statements related to future events or to the company's future financial or operating performance such as the company's expectations and projections regarding its growth, initiatives and strategies, capital expenditures and investments, customer and partner relationships, major projects and product development. These statements may generally, but not always, be identified by the use of words such as "target," "goal," "aim," "believe," "expect," "commit," "anticipate," "intend," "estimate," "should," "will," "shall," "may," "likely," "plan," "strategy," "initiative," "project," "outlook" or similar expressions, including variations and the negatives thereof.

Forward-looking statements reflect the company's expectations, beliefs, estimates, forecasts, projections and assumptions, only as of the date such statements are made, and are subject to known and unknown risks, uncertainties and other important factors beyond the company's control that could cause the company's actual results, performance or achievements to be materially different from the expected results, performance, or achievements expressed or implied by such statements. Factors that could cause actual results to differ materially from the company's expectations include, among other things, the following: global supply, demand and price fluctuations of oil, gas and petrochemicals; global economic conditions; competition in the industries in which the company operates; climate change concerns, weather conditions and related impacts on the global demand for hydrocarbons and hydrocarbon-based products; risks related to the company's ability to successfully meet its ESG targets, including its failure to fully meet its GHG emissions reduction targets by 2050; conditions affecting the transportation of products; operational risk and hazards common in the oil and gas, refining and petrochemicals industries; the cyclical nature of the oil and gas, refining and petrochemicals industries; political and social instability and unrest and actual or potential armed conflicts in the MENA region and other areas; natural disasters and public health pandemics or epidemics; the management of the company's growth; the management of the company's subsidiaries, joint operations, joint ventures, associates and entities in which it holds a minority interest; exposure to inflation, interest rate risk and foreign exchange risk; 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; legal proceedings, international trade matters, and other disputes or agreements; and other risks and uncertainties that could cause actual results to differ from the forward-looking statements in this presentation, as set forth in the latest periodic reports filed by the Saudi Arabian Oil Company ("Aramco") with the Saudi Exchange. For additional information on the potential risks and uncertainties that could cause actual results to differ from those presented please see Aramco's most recent annual periodic report filed with the Saudi Exchange and any subsequent filings thereto.

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iktva Program Overview (1/2)

The In-Kingdom Total Value Add (iktva) program is designed to drive increased investment, economic diversification, job creation, and workforce development within the Kingdom

Saudi Aramco aims to achieve 70% localization of all spending




iktva in Procurement

2000+ Service contracts	290+ Corporate purchase agreements
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Business Opportunities

12 Sectors	210 Business Opportunities	\$28 bn Annual Market Size
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Anchor Projects

6 Anchor projects

 IMI	 SPARK	 Tuwaiq
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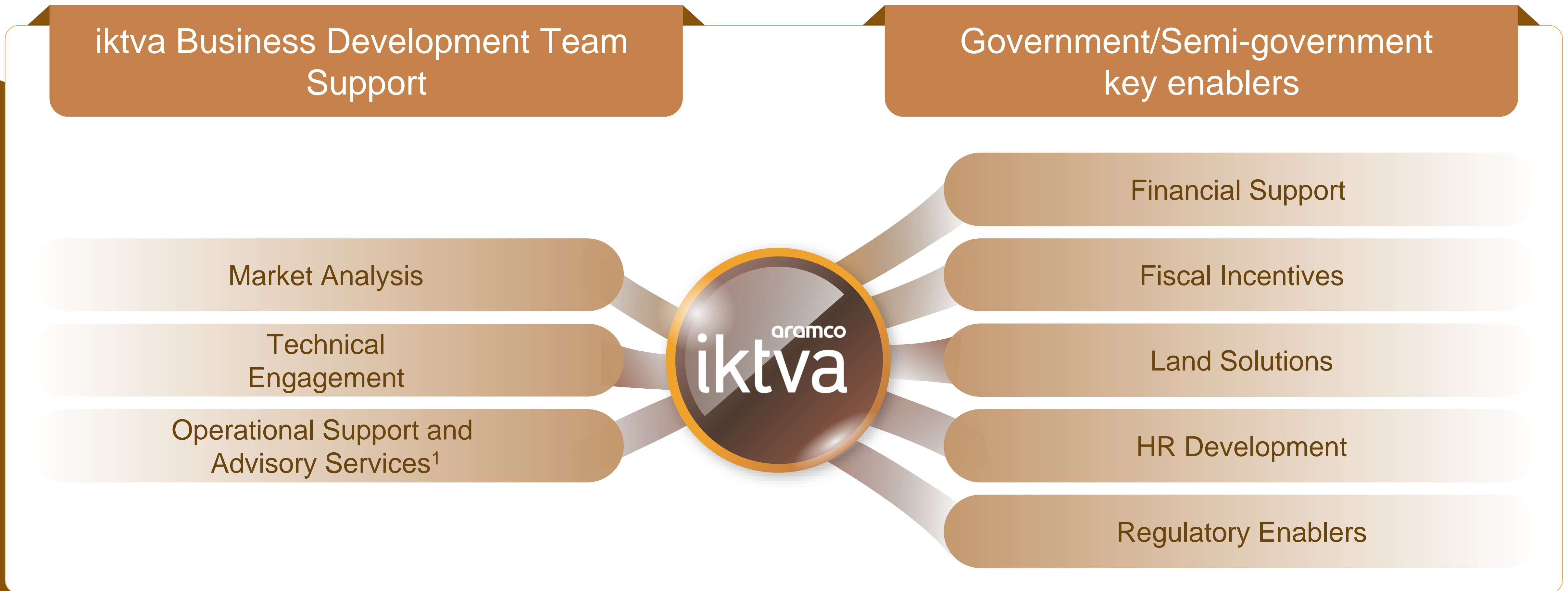


Local Workforce Development

16 National training centers	90+ Programs
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Catalyzing Supply Chains

Note: IMI = International Maritime Industries; SPARK = King Salman Energy Park











Catalyzing Supply Chains

1. Includes broad range of support services provided by the team: user requirements, advisory on available financial and fiscal incentives, guidance on localization process in line with local regulations and standards, action plan development etc.

Why invest in KSA?

Non-exhaustive

 Strong GDP growth and healthy economy	 Big market and game-changing opportunities	 Government incentives and enablers	 Ease of doing business	 Strategic global location	 Favorable demographics
Top 20 economies globally	5 Special Economic Zones drive innovation	\$1.3T+ invested in private sector by 2030	 one of world's most rewarding tax systems	12-15% of global trade passes via Red Sea	17% population growth from 2013-2023
GDP growth among highest projected in 2025 in top economies	6 giga projects driving urbanization and industry	5.7% contribution of FDI to GDP by 2030	Top 5 in the MENA region for ease of doing business	 KSA container ports are among the most efficient globally	67% of population below the age of 35

Catalyzing Supply Chains

Note: FDI = Foreign Direct Investment
 Source: IMF; MISA; Vision 2030 Key Performance Indicators; Shareek Program; World Bank

Non-exhaustive

1 Subsidies and financial programs

Loans financing up to 75% of the industrial project provided by SIDF to foster industrial development

2 Tax incentives and exemptions

Tax exemptions for earnings from exports and up to 50% tax credit on Saudi nationals' payroll and training costs for 10 years

3 Industrial Zones and Economic Cities

Industrial zones like Plaschem Park and Jubail Industrial City provide specialized infrastructure and logistical services essential for chemical manufacturing

4 Customs and import duty reductions

MIM offers zero import duties for localization of selected raw materials, machinery, & equipment

5 Visa and legal support

Streamlined visas for investors and skilled workers, with legal support via MISA for fast business setup and compliance



Catalyzing Supply Chains

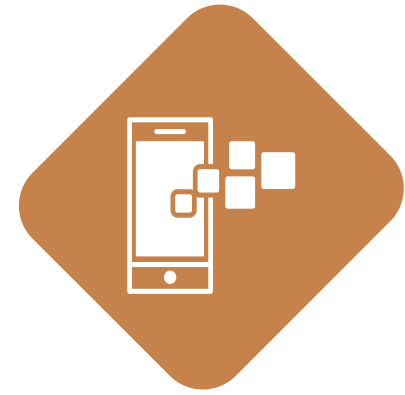
Note: SIDF - Saudi Industrial Development Fund; MIM: Ministry of Industry and Mineral Resources; MISA = Ministry of Investment Saudi Arabia
 Source: SIDF; ZATCA; SPARK, MoCI; MISA

Four key drivers for the KSA process chemicals market



Consumer industry trends

- Growing demand and investments in petrochemical conversion (e.g., SABIC, SIPCHEM) and water treatment (e.g., 8% CAGR growth in wastewater treatment) sectors within the Kingdom to realize Vision 2030 expecting to drive significant demand growth for process chemicals



Technological advancements

- Advancements in technology are enabling a sustainable future in chemical manufacturing, with innovations like catalyst technologies allowing more energy-efficient processes



Sustainability and environmental regulations

- Kingdom's sustainability initiatives aim to make core industries more responsible and compliant (e.g., Saudi Environmental Standards), driving growth in sustainable process chemicals




Economic factors

- Ambition of the Kingdom to increase value beyond oil exports by tapping into O&G opportunity conversions domestically, including megaprojects such as the Amiral complex

Catalyzing Supply Chains

Process chemicals demand supported by current and future megaprojects


Non-exhaustive



Sadara

Performance plastics & chemicals in 26 manufacturing plants with a capacity of over 3 MM tons per year


Existing



Amiral

New production complex with a 1,650 M tons per annum capacity of ethylene and other industrial gases


Under development



Crude Oil-to-Chemicals

Expected to produce about 9 MM tons of petrochemicals per year, converting 400,000 barrels per day of oil into chemicals


Under development



Carbon Capture & utilization Plant

A mega plant by SABIC that captures 500 M tons of CO2 per year by producing ethylene glycol and converting it into feedstock

Existing



SIPCHEM blue ammonia plant

SIPCHEM partnership with Linde expected to produce 1.3 MM tons of blue ammonia in KSA

Under development

How do we define what is an opportunity?



Growing market

High growth high spend markets



**Limited local players
& import driven**

*Markets with few local contributors
and high import resilience*



**Technological
& labor feasibility**

*Markets with accessible or
standardized technology and
available skilled labor*

Process Chemicals Market Overview

KSA process chemicals

10 opportunities to be discussed today

\$1.3 B
5% CAGR¹

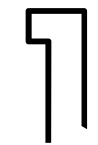
2024 KSA market size for opportunities
in today's workshop

- 1 Process catalysts
- 2 Antifreeze
- 3 Solid desiccant
- 4 Methyl diethanolamine
- 5 Polytetrafluoroethylene
- 6 Alpha olefins
- 7 Masterbatch
- 8 Adipic Acid
- 9 CO2 removal agents
- 10 CCS additives

Process Catalysts

Business Opportunity

Opportunity profile



Process catalysts are critical to realize KSA's industrial diversification strategy and ongoing O&G expansion



Process catalyst market is sizeable and expected to remain stable



Attractive investment opportunities exist within the value chain

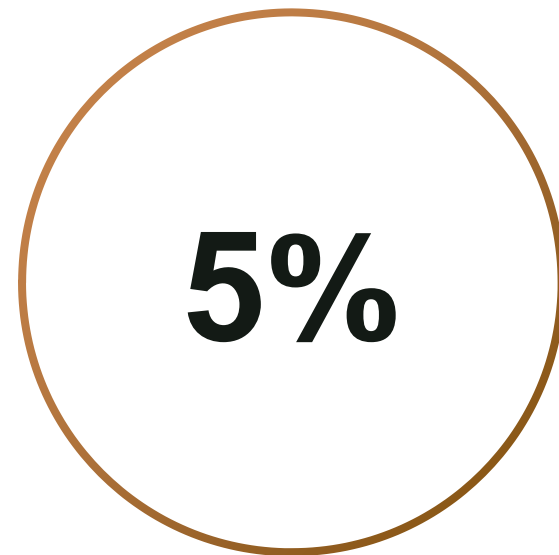
Type(s)

Ceramic balls	Specific gravity: 2.5 - 3.5
Titanium dioxide	Specific gravity: 3.9 - 4.2
Non-precious metals	Specific gravity: 5 - 9
Superclause selective	Specific gravity: 3.5 - 4.5
Precious metals	Specific gravity: 10 - 22
Selective oxidation	Specific gravity: 3 - 5

Catalyzing Supply Chains

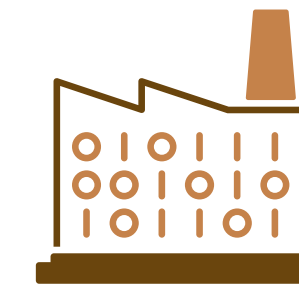


Estimated 2024 KSA market size



Forecasted 5-year CAGR

KSA value chain opportunities



Product formulation

Technical overview

PROCESS CATALYSTS

Catalyst: Ceramic balls¹

Specific Gravity: 2.5 – 3.5

Form: Spherical with a mixture of alumina and inert ceramics

Catalyst: Precious metals²

Specific Gravity: 10-22

Form: Powder, pellets, or supported on substrate

Catalyst: Non-precious metals³

Specific Gravity: 5-9

Form: Powder or pellet form

Catalyst: Titanium dioxide⁴

Specific Gravity: 3.9 – 4.2

Form: Cylindrical extrudates used as claus catalyst

Selective oxidation catalyst⁵

Specific Gravity: 3 – 5

Form: Mixture of primarily silicon dioxide and aluminum oxide

Superclaus selective catalyst⁶

Specific Gravity: 3.5 – 4.5

Form: Mixture of activated silica and inert alumina in 25%-75% volume

Oil & Gas applications

- Petroleum refining
- Gas processing

Other applications

- Petrochemical processing
- Synthesis of polymer

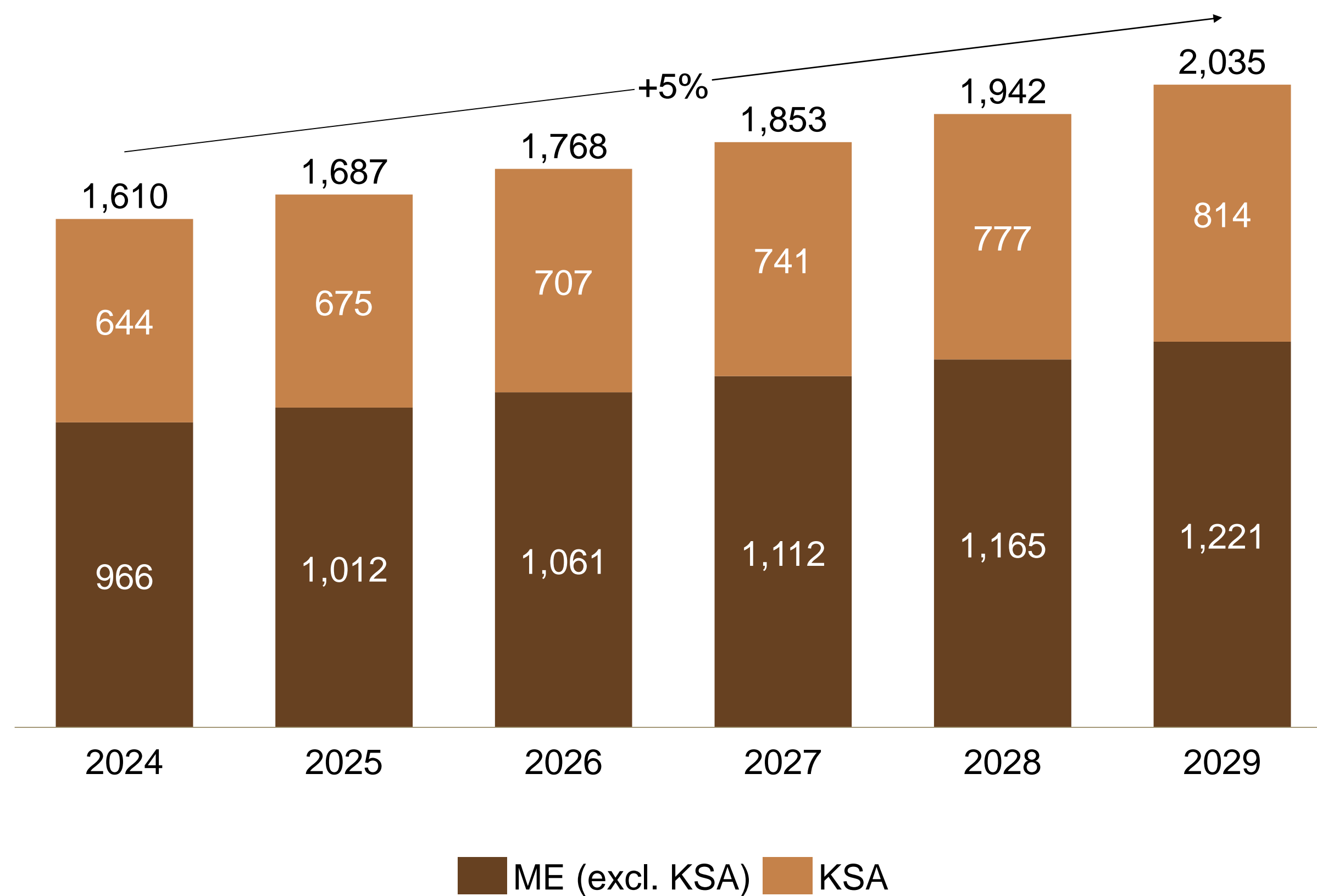
Catalyzing Supply Chains

1. Aramco material number 6000001767 2. Aramco material number 6000001812 3. Aramco material number 6000001716 4. Aramco material number 1000775823 5. Aramco material number 1001058453 6. Aramco material number 1000878234

Source: Expert interviews, Saudi Aramco analysis, team analysis

Process catalyst demand, customers, and drivers

Forecasted Middle East process catalyst market 2024-2029 (\$MM)



Typical customers in KSA



Oil & Gas players



Petrochemical manufacturers

Key KSA demand drivers

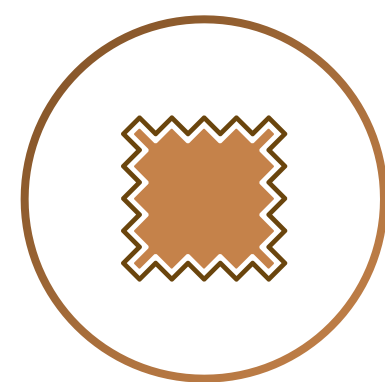
- **Consumer industry demand:** Expansion plans of KSA's O&G sector leads to steady need for petroleum refining catalysts
- **Economic factors:** Industrial diversification and increased production of polymer and chemical MFE driving growth for chemical processing catalysts

Process Chemicals workshop

Catalyzing Supply Chains

Notes: MFE = Manufacturing
Source: S&P global commodity insights, expert interviews, team analysis

Value chain and key localization opportunities



Raw materials

Local saturation

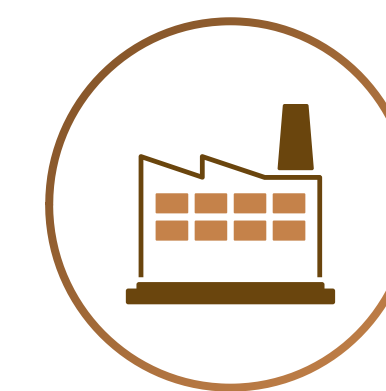


Multiple players

Current value chain



- Silica, alumina, titanium dioxide are locally available
- PGMs imported with steady supply available for local consumption



Product formulation



Few players

- Opportunity to localize manufacturing of process catalysts¹

Opportunity

- Catalyst solutions and IP for oil to chemical from leading players

- Chemical engineers with expertise in catalyst formulation and quality control

Success factors

Technology



Labor



Catalyzing Supply Chains

1. Presence of limited player for certain catalysts such as hydrotreating, three upcoming plants for chemical processing announced

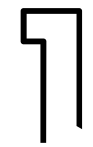
Note: PGM = Platinum grade metals

Source: Expert interviews, team analysis

Antifreeze

Business Opportunity

Opportunity profile



Antifreeze is a critical component to realize the ongoing KSA industrial diversification strategy



Antifreeze market in the region projected to show steady growth



Attractive investment opportunities exist within the value chain

Type(s)

Triethylene glycol

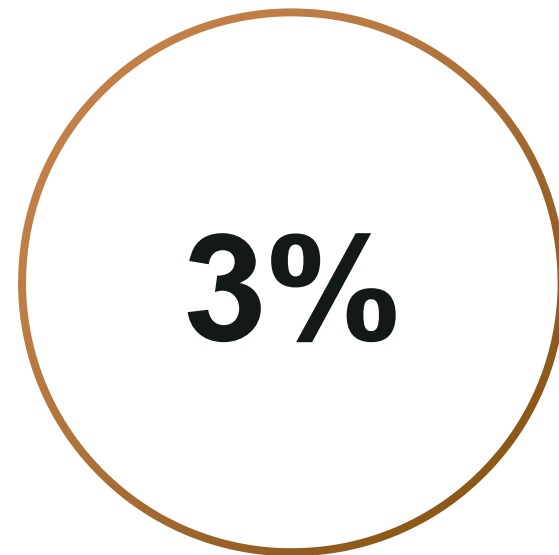
Specific gravity:
1.1

Monoethylene glycol

Specific gravity:
1.1

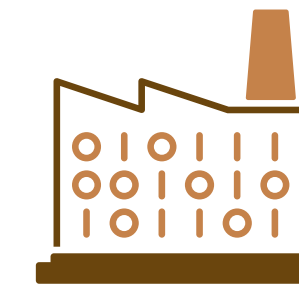


Estimated 2024 KSA market size



Forecasted 5-year CAGR

KSA value chain opportunities



Product formulation

Technical overview

Monoethylene glycol (MEG)¹

General specifications

- Chemical formula: $C_2H_6O_2$

- Specific Gravity: 1.1

- Form: Colorless odorless liquid

Oil & Gas applications

- Industrial coolant
- Hydraulic solutions
- Dehydrating agent in gas plants

Triethylene glycol (TEG)²

General specifications

- Chemical formula: $C_6H_{14}O_4$

- Specific Gravity: 1.1

- Form: Colorless odorless liquid

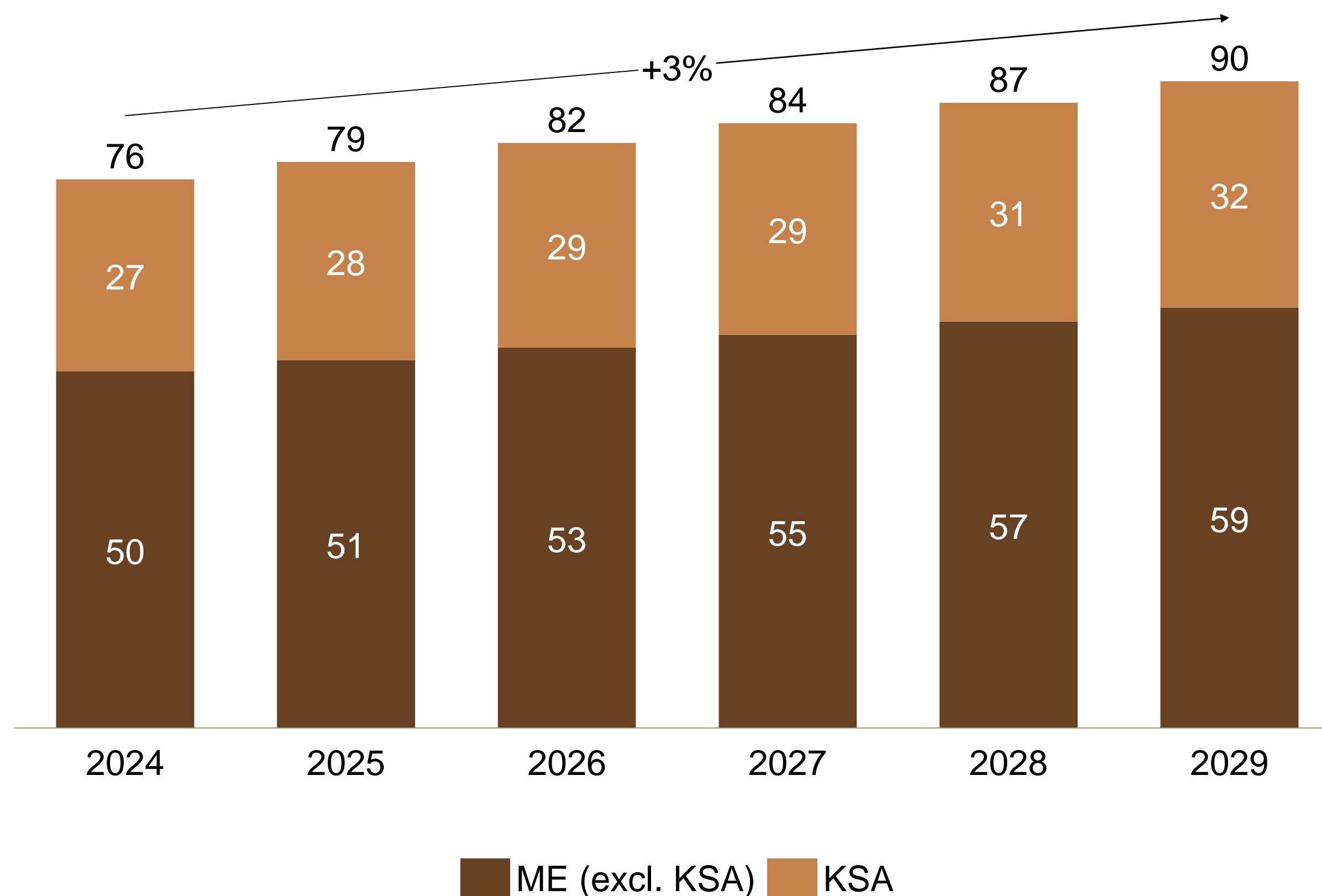
Other applications

- Automotive engine cooling
- Refrigeration systems
- Food and beverage processing

Catalyzing Supply Chains

Antifreeze demand, customers, and drivers

Forecasted Middle East antifreeze market 2024-2029 (\$MM)



Typical antifreeze customers in KSA



Oil & Gas players



Petrochemical industry



Automotive industry¹

Key KSA demand drivers

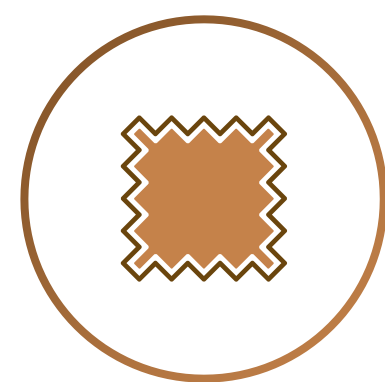
- **Consumer industry trends:** Expansion plans for gas plants and increased production in the Kingdom leading to increased need for antifreeze products
- **Economic & demographic factors:** Increased vehicle ownership boosting demand for engine coolants

Catalyzing Supply Chains

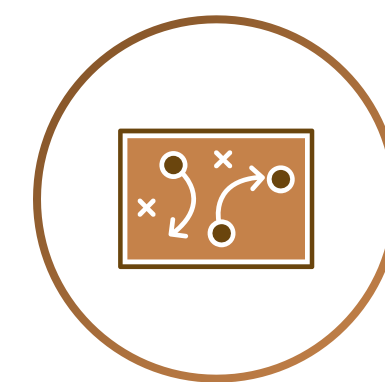
1. Main consumers being dealerships, service centers and independent workshops for automobiles coolant (similar mixture to antifreeze with slightly composition)

Source: S&P global commodity insights, expert interviews, team analysis

Value chain and key localization opportunities



Raw materials



Intermediate process



Product formulation

Local saturation



Multiple players



Multiple players



Few players

Current value chain

- Ethylene Oxide, Diethylene Glycol (DEG) are locally available

- Intermediary products such as monoethylene glycol (MEG) and triethylene glycol (TEG) are locally available

- Opportunity to localize antifreeze (blended formulation of MEG / TEG with water and additives) products

Opportunity

Success factors

Technology



Labor



- Advanced formulation and purification systems

- Chemical engineers & technicians specialized in glycol production

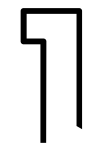
Process Chemicals workshop

Catalyzing Supply Chains

Solid Desiccant

Business Opportunity

Opportunity profile



High need of solid desiccants in gas plants and industrial manufacturing



Solid desiccants are a niche market with moderate growth



Attractive investment opportunities for investors in solid desiccant value chain

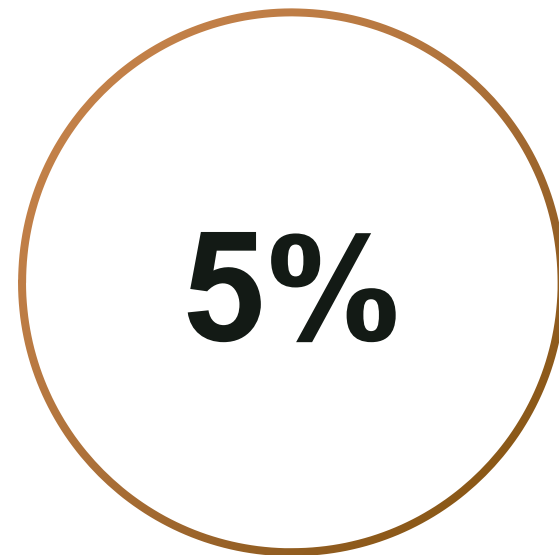
Type(s)

Solid Desiccant

Specific gravity:
 0.7 -2.2¹

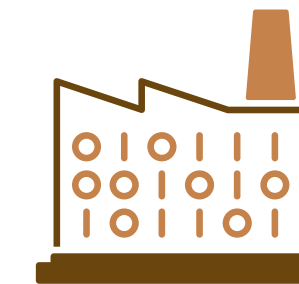


Estimated 2024
 KSA market size



Forecasted 5-year
 CAGR

KSA value chain opportunities



Product formulation

Catalyzing Supply Chains

1. Depending on the type and composition of molecular sieves, activated alumina, and silica gel
 Source: Expert interviews, Saudi Aramco data, team analysis

Technical overview

Solid Desiccant¹

General specifications

- Key categories: Usually aluminum based, molecular sieve, activated alumina or silica gel based
- Strong physical adsorption properties
- Primarily used for removal of water from gas or liquid hydrocarbon

Oil & Gas applications

- Natural gas dehydration
- Dehydrating CO₂ for EOR

Other applications

- Solvent and hydrocarbon drying
- Compressed air drying
- Humidity control for electronics packaging
- Protection for moisture sensitive catalysts
- Pharmaceutical product storage

Catalyzing Supply Chains

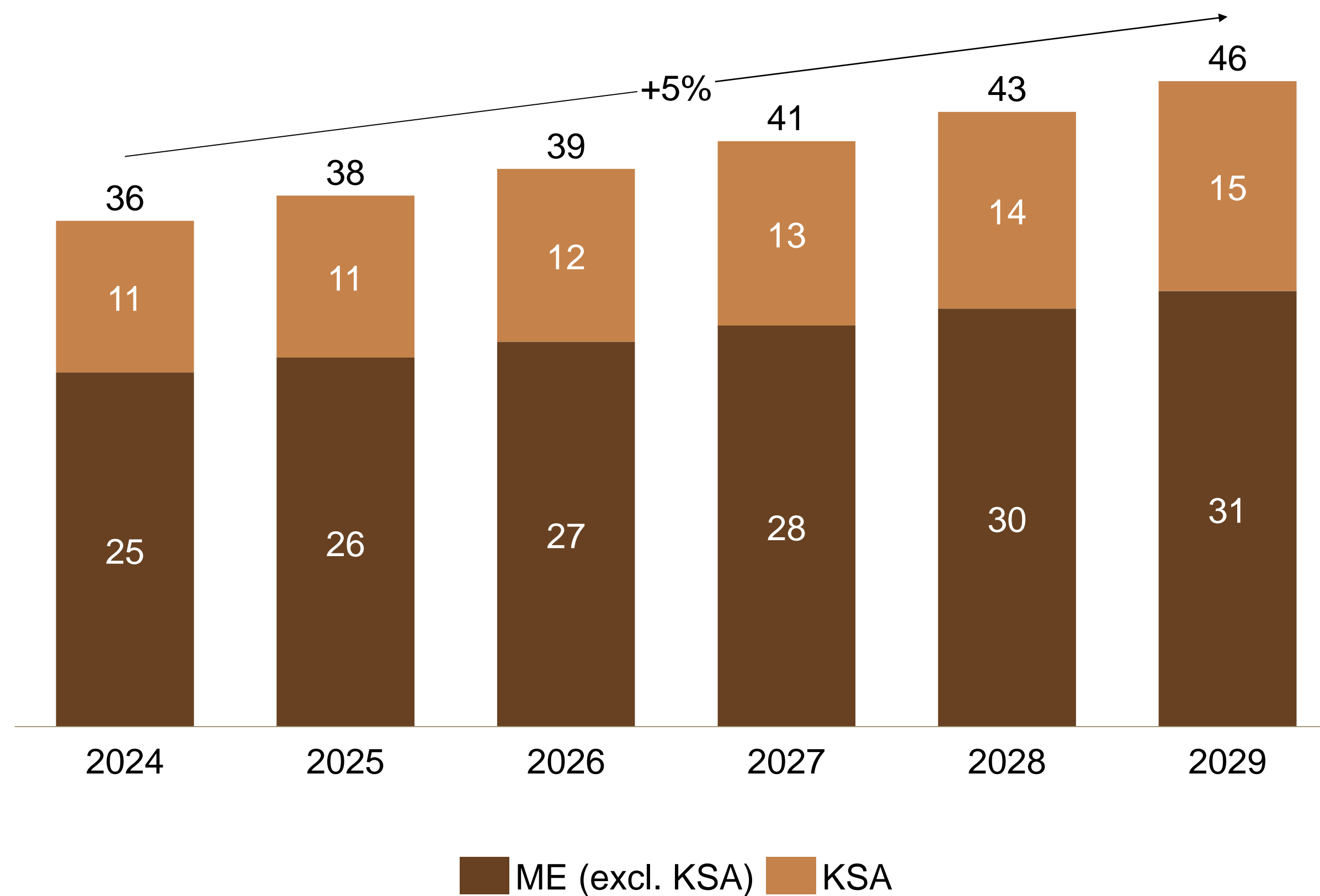
1. Aramco material numbers 6000001790

Note: Enhanced Oil Recovery




Source: Expert interviews, team analysis

Solid desiccant demand, customers, and drivers

Forecasted Middle East solid desiccant market 2024-2029 (\$MM)



Typical customers in KSA

-  Oil & Gas players
-  Industrial manufacturers
-  Pharmaceutical industry

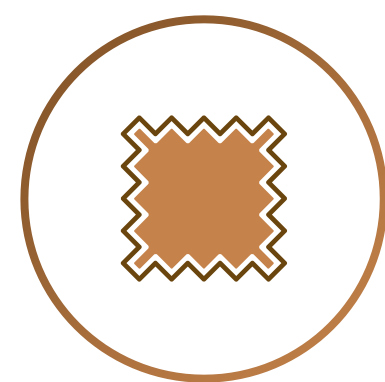
Key KSA demand drivers

- **Industry demand:** Expansion of O&G operations drive demand for solid desiccants as they are necessary for gas dehydrating solutions
- **Economic drivers:** Growth in non-oil sectors leads to demand increase in desiccants as a dehydrating agent and protection against moisture

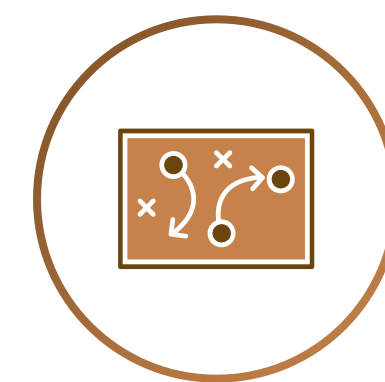
Process Chemicals workshop

Catalyzing Supply Chains

Value chain and key localization opportunities



Raw materials



Intermediate process



Product formulation

Local saturation



Multiple players

Current value chain

- Raw materials such as alumina and silica available locally



Multiple players

- Intermediary products such as sodium silicate locally available



Few players

- Opportunity to localize production of solid desiccants

Opportunity

Success factors

Technology



Labor



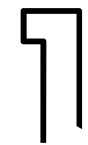
- Calcination / activation furnaces and tech for sol-gel processing
- Material scientists and furnace production technicians

Catalyzing Supply Chains

Methyldiethanolamine (MDEA)

Business Opportunity

Opportunity profile



MDEA's are critical to realize ongoing gas plant expansion and sustainability plans



MDEA market is expected to show moderate growth in the next 5 years



Attractive investment opportunities for investors in MDEA value chain

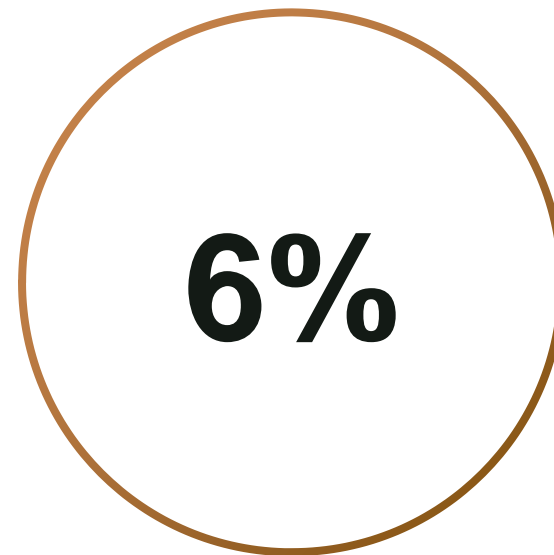
Type(s)

Methyl diethanolamine

Specific gravity: 1.04-1.041

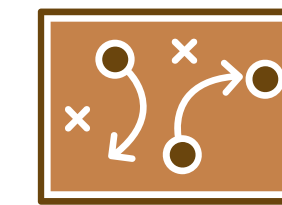


Estimated 2024 KSA market size

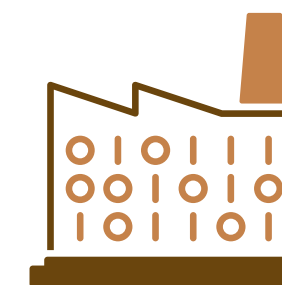


Forecasted 5-year CAGR

KSA value chain opportunities



Intermediate process



Product formulation

Technical overview

Methyldiethanolamine¹

General specifications

- Chemical formula: $C_5H_{13}NO_2$
- Specific Gravity: 1.04 – 1.041
- Form: Colorless to pale yellow liquid



Oil & Gas applications

- Gas sweetening agent
- Amine blends for improved absorption



Other applications

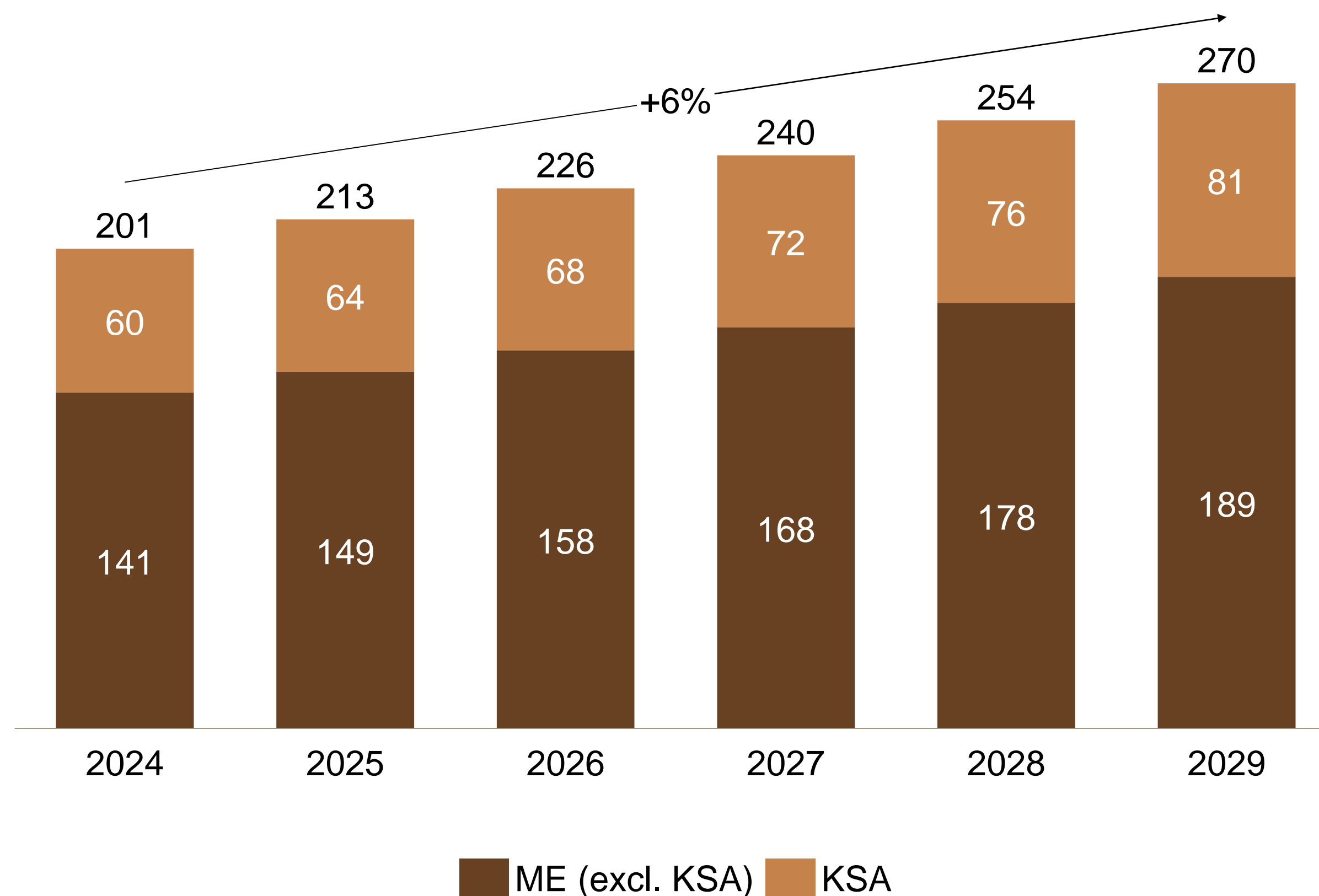
- Removal of H₂S in petrochemical plants
- CO₂ removal in CCUS
- Acidic gas removal from wastewater

Catalyzing Supply Chains

1. Aramco material numbers 1000959459 and 1001032210
Source: Expert interviews, Saudi Aramco analysis, team analysis

Methyldiethanolamine (MDEA) demand, customers, and drivers

Forecasted Middle East MDEA market 2024-2029 (\$MM)



Typical customers in KSA



Oil & Gas players



Petrochemical manufacturers



Industrial manufacturers

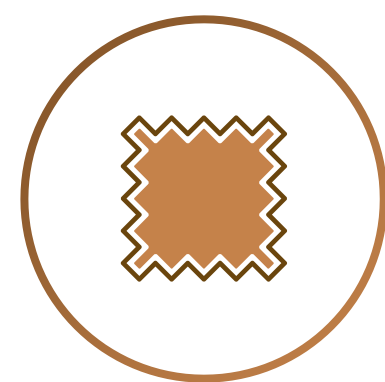
Key KSA demand drivers

- **Consumer Industry growth:** Growing production for gas leading to an increased need for MDEA as a gas sweetening agent
- **Sustainability and economic factors:** Growth in CCUS technology as part of Vision 2030 leading to an increase in MDEA demand as an agent for CO₂ absorption

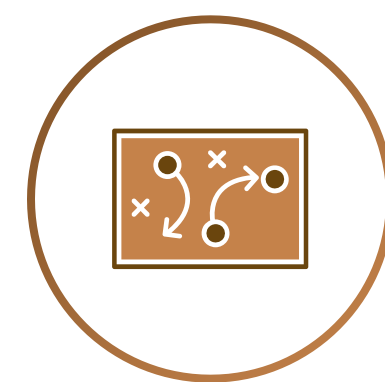
Catalyzing Supply Chains

Notes: CCUS: Carbon capture utilization and storage
Source: Expert interviews, Saudi Aramco data, team analysis

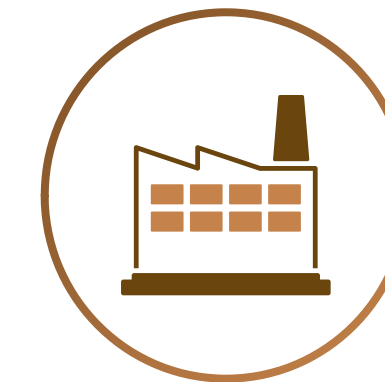
Value chain and key localization opportunities



Raw materials



Intermediate process



Product formulation

Local saturation



Multiple players

Current value chain

- Methanol, ammonia, and formaldehydes available locally



Few players

- Opportunity to localize the production of intermediary products such as methylamines



No players

- Opportunity to localize MDEA production

Opportunity

Opportunity

Success factors

Technology



- Methylamine production IP and advanced machinery

Labor



- Engineers with expertise in optimizing chemical processes

- Chemical engineers with expertise in catalyst formulation

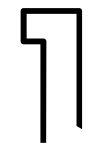
Process Chemicals workshop

Catalyzing Supply Chains

Polytetrafluoroethylene (PTFE)

Business Opportunity

Opportunity profile



KSA needing PTFE for growing industrial manufacturing, automotive and petrochemical industries

Type(s)

Polytetrafluoroethylene: Dispersion

Polytetrafluoroethylene: Fine powder

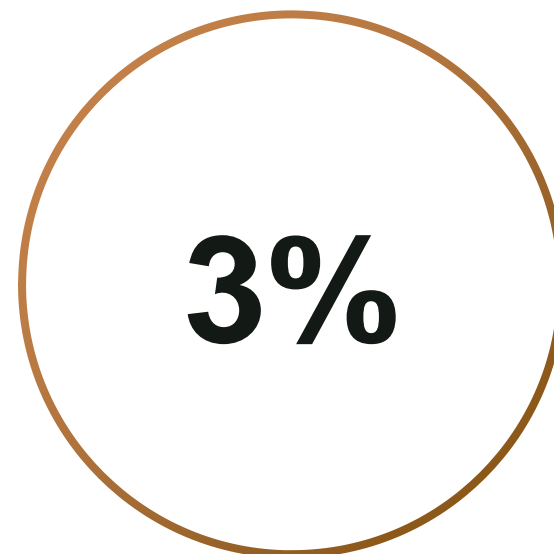
Polytetrafluoroethylene: Granular



PTFE market is forecasted to show steady growth in the next 5 years



Estimated 2024 KSA market size

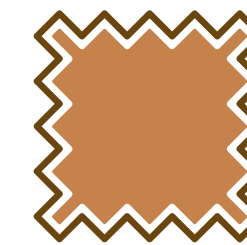


Forecasted 5-year CAGR

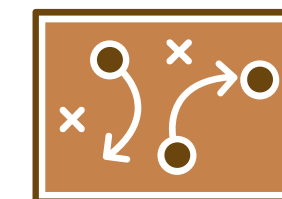


Attractive investment opportunities exist within the value chain

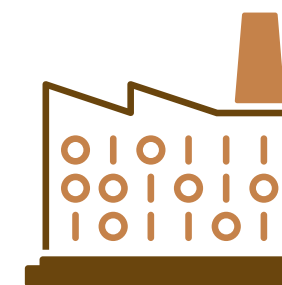
KSA value chain opportunities



Raw material



Intermediate process



Product formulation

Catalyzing Supply Chains

Notes: PTFE = Polytetrafluoroethylene
 Source: Expert interviews; Team analysis

Technical overview

Polytetrafluoroethylene: Dispersion

General specifications

- Chemical formula: $(C_2F_4)_n$
- Specific gravity: 1.5 – 1.55

Polytetrafluoroethylene: Fine powder

General specifications

- Chemical formula: $(C_2F_4)_n$
- Specific gravity: 2.15 – 2.20

Polytetrafluoroethylene: Granular

General specifications

- Chemical formula: $(C_2F_4)_n$
- Specific gravity: 2.13 - 2.16

Oil & Gas applications

- Additive in drilling fluid
- Seals and gaskets in pipelines
- Valve components
- Pads, bearings, and bushings

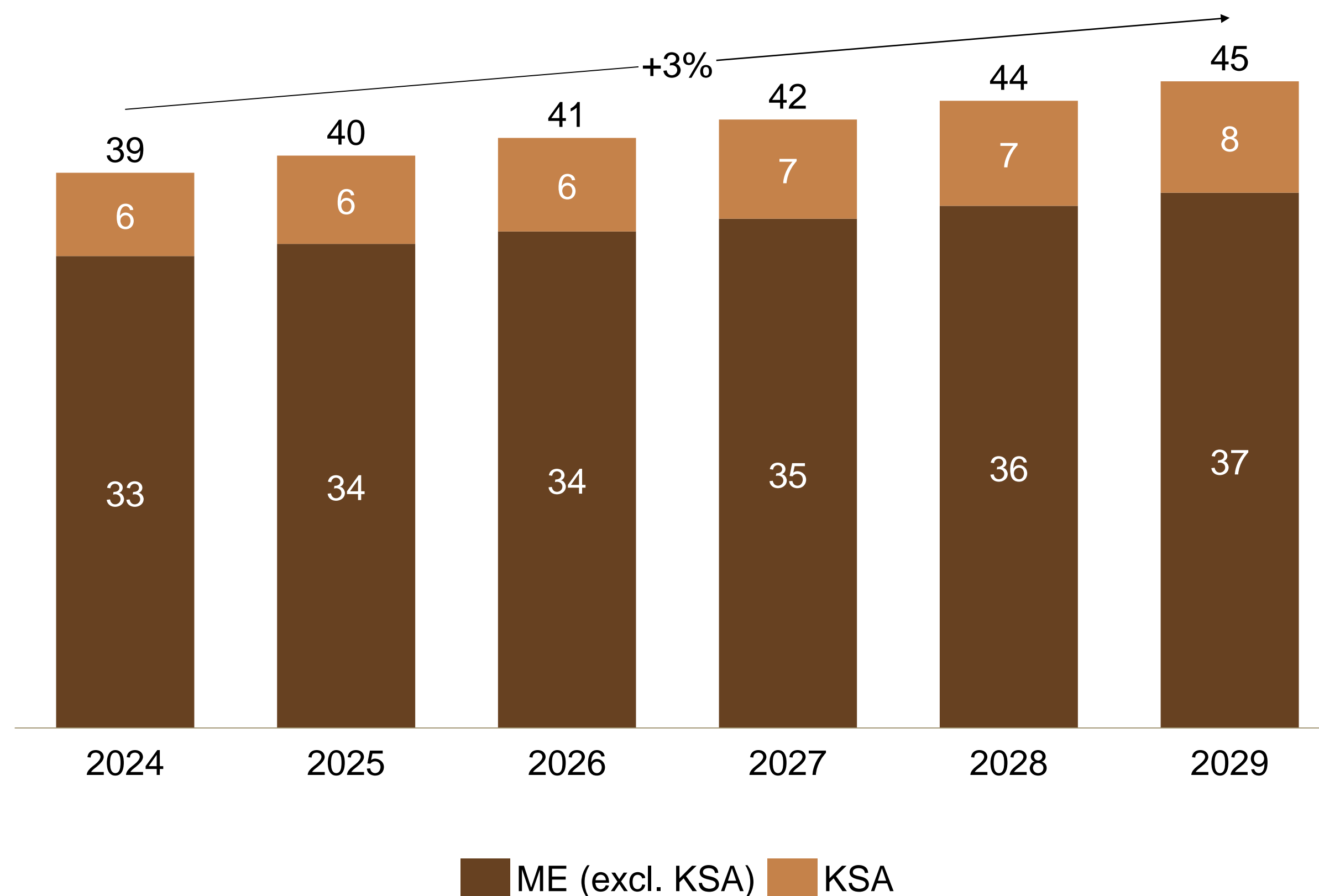
Other applications

- Coatings and insulation
- Automotive hoses
- High performance wires and cables

Catalyzing Supply Chains

Polytetrafluoroethylene demand, customers, and drivers

Forecasted Middle East PTFE market 2024-2029 (\$MM)



Typical customers in KSA



Oil & Gas players



Petrochemical manufacturers



Industrial manufacturing

Key KSA demand drivers

- **Consumer demand:** Rise in upstream activities leading to increase in demand for PTFE used as valve sealants, pipe coatings by suppliers and drilling fluid additive
- **Economic factors:** Industrial diversification and increased production of polymer and chemical MFE driving growth for chemical processing catalysts

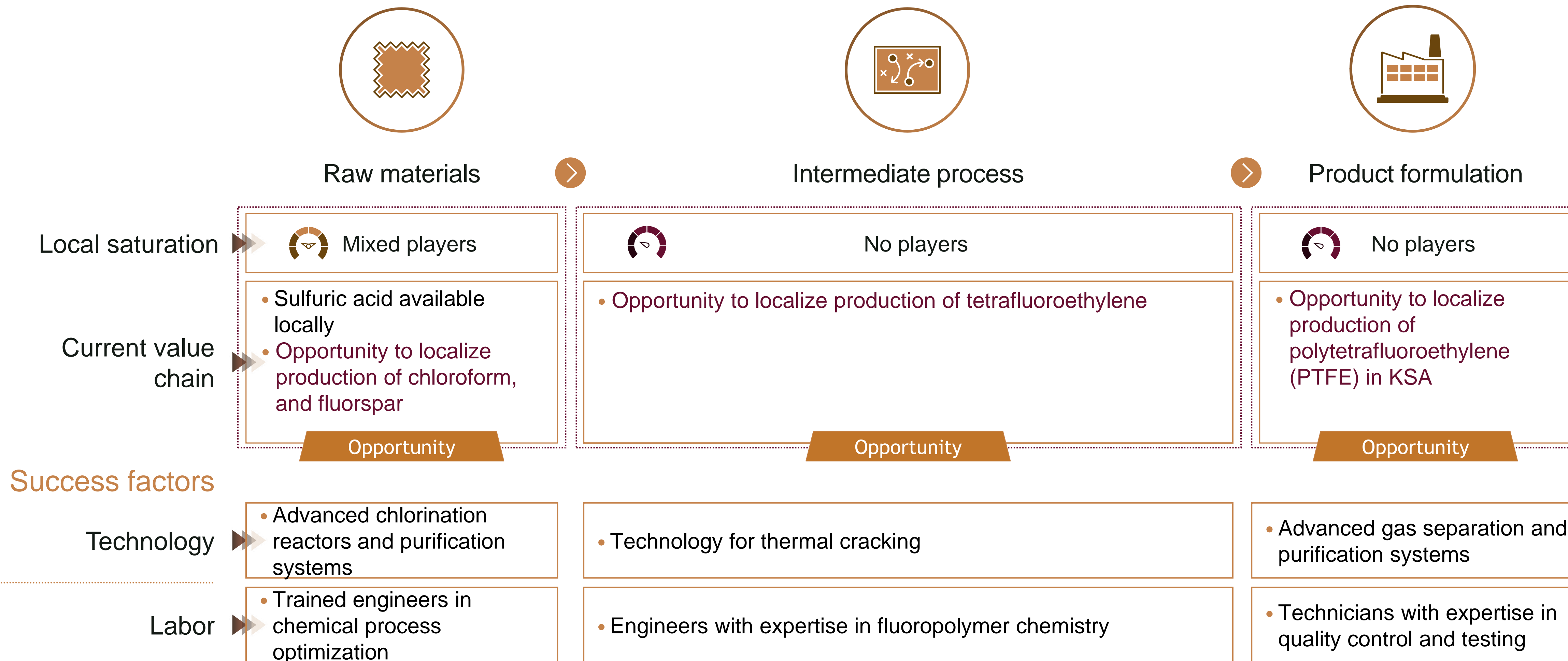
Catalyzing Supply Chains

MFE = manufacturing

Note: Middle East includes Turkey

Source: S&P global commodity insights, expert interviews, team analysis

Value chain and key localization opportunities



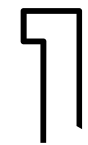
Process Chemicals workshop

Catalyzing Supply Chains

Alpha olefins

Business Opportunity

Opportunity profile



Growing need for alpha olefins to meet growing O&G expansion and industrial diversification



Alpha olefin market expected to show steady growth



Attractive investment opportunities exist within the value chain

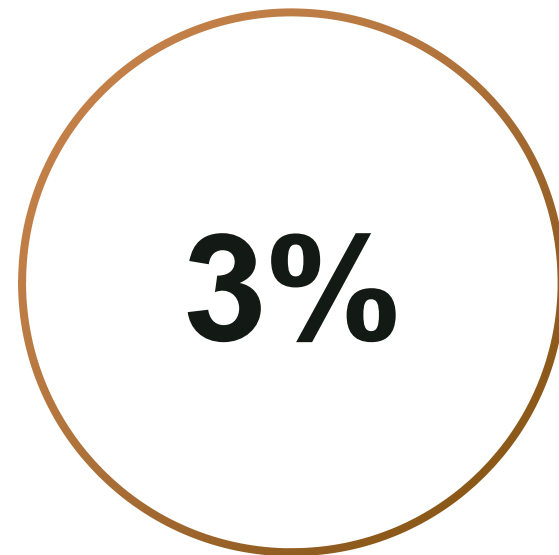
Type(s)

Alpha olefins

Specific gravity:
0.6 – 0.8

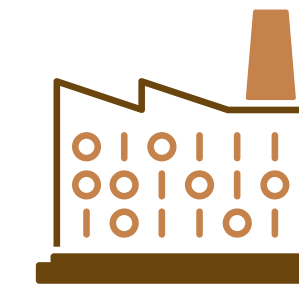


Estimated 2024
KSA market size



Forecasted 5-year
CAGR

KSA value chain opportunities



Product formulation

Catalyzing Supply Chains

Technical overview

Alpha olefins

General specifications

- Key categories: Isomerized olefins and higher alpha olefins¹
- Chemical formula: C_nH_{2n}
- Specific gravity: 0.6 – 0.8
- Immiscible with water



Oil & Gas applications

- Formulation base for oilfield chemicals
- Corrosion inhibitors for pipelines¹



Other applications

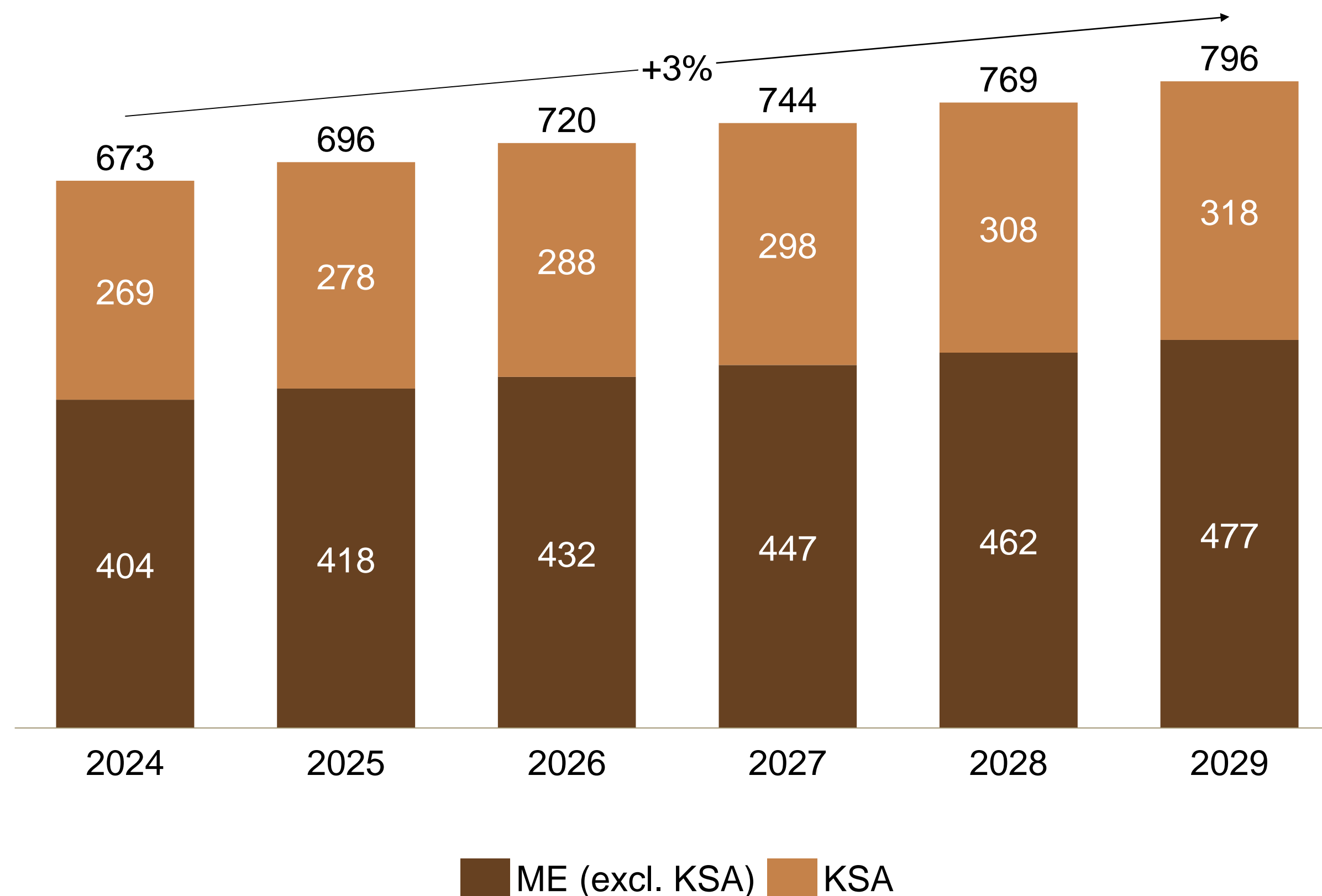
- Comonomer used for polyethylene production
- Used to produce synthetic lubricants
- Utilized to produce bio-plastics²

Catalyzing Supply Chains




1. Poly alpha olefins, 2. Varies based on the LTS of non-metallic pipelines
 Source: Expert interviews, team analysis

Alpha olefins demand, customers, and drivers

Forecasted Middle East alpha olefins market 2024-2029 (\$MM)



Typical end-product customers in KSA

-  Oil & Gas players
-  Petrochemical manufacturers
-  Industrial manufacturing

Key KSA demand drivers

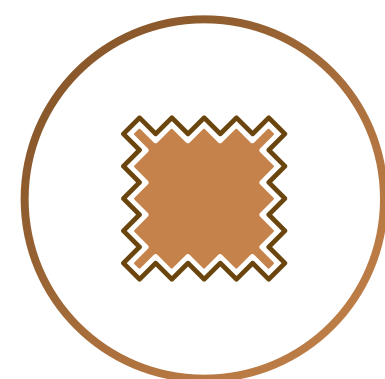
- **Consumer industry demand:** Rise in upstream activities leading to increased demand for alpha olefins used as raw materials for oilfield chemicals
- **Economic factors:** Industrial diversification and increased production of polymer and chemical MFE driving growth for alpha olefins used as raw material

Process Chemicals workshop

Catalyzing Supply Chains

Notes: MFE = Manufacturing
Source: S&P global commodity insights, expert interviews, team analysis

Value chain and key localization opportunities



Raw materials

Local saturation



Multiple players

Current value chain



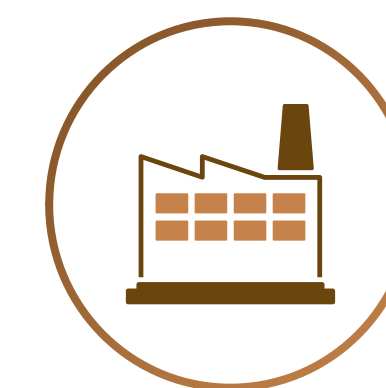
- Raw materials such as ethylene, sodium hydroxide locally available

Success factors

Technology



Labor



Product formulation



Few players¹

- Opportunity to localize production of alpha olefins in KSA

Opportunity

- Advanced oligomerization technology

- Skilled chemical engineers for optimizing chemical processes

Catalyzing Supply Chains

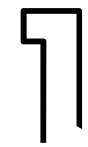
1. Announcement for production plant by INEOS in the Amiral project

2. Source: Expert interviews, team analysis

Masterbatch

Business Opportunity

Opportunity profile



Growing demand for masterbatch as a result of industrial diversification strategy and increased manufacturing



Masterbatch is expected to show strong growth over the next 5 years



Attractive investment opportunities exist within the value chain

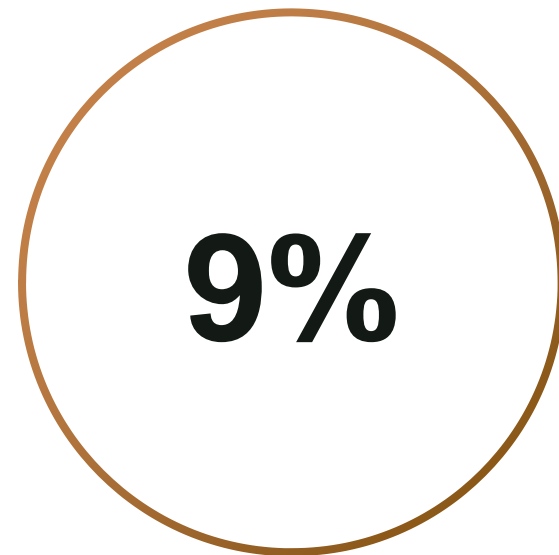
Type(s)

Master-batch

Specific gravity:
1.1 – 2

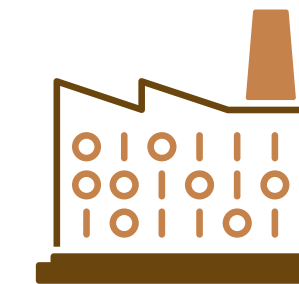


Estimated 2024
KSA market size



Forecasted 5-year
CAGR

KSA value chain opportunities



Product formulation

Technical overview

Masterbatch

General specifications

- Key categories: White, black, color, additive, filler
- Specific gravity: 1.1 – 2



Oil & Gas applications

- Flexible pipelines
- Cable insulation and sheathing
- Tank and vessel linings
- Protective films



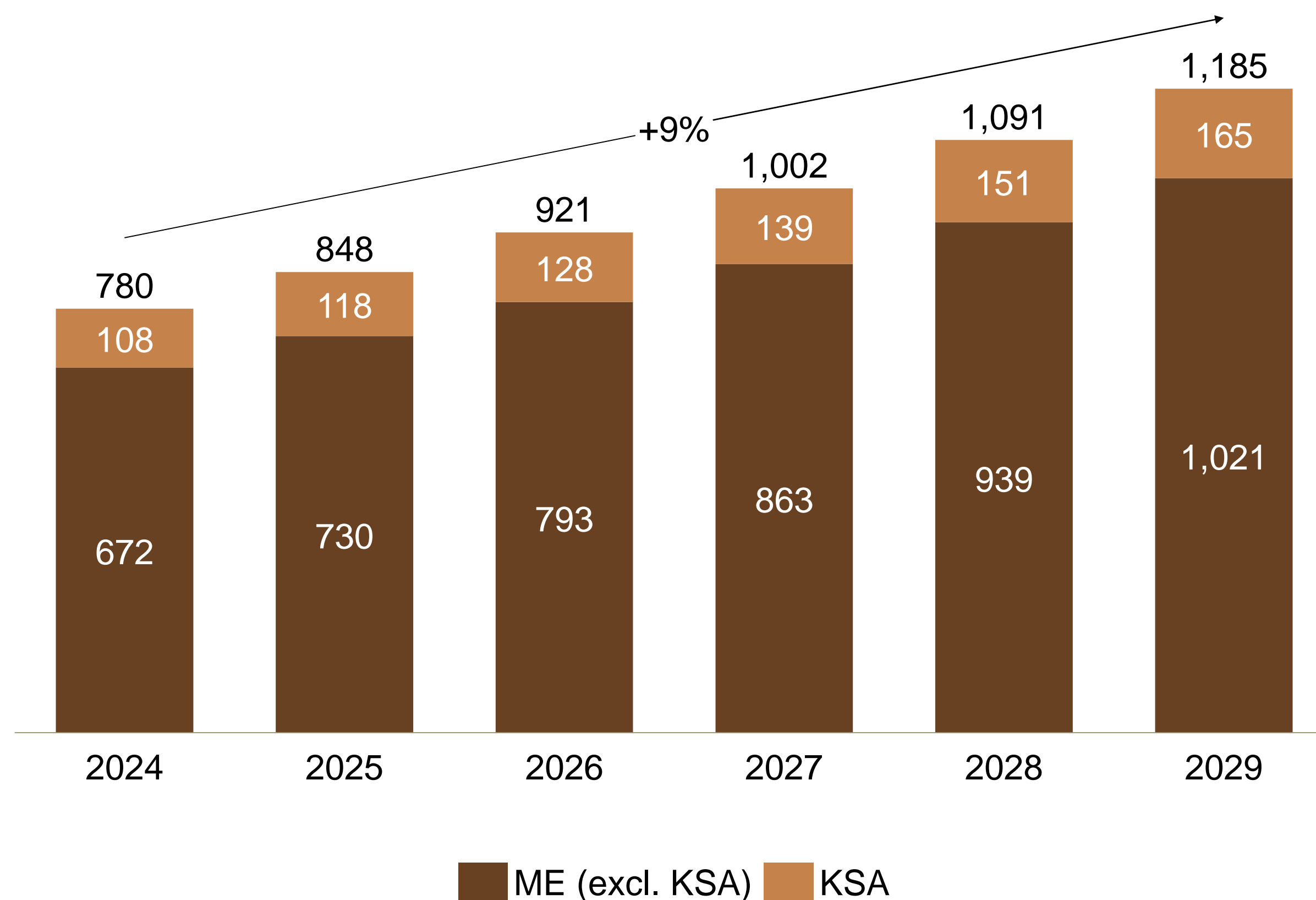
Other applications

- Polymer processing for industrial packaging, automobile components, insulation products
- Colorant for plastics



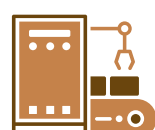
Catalyzing Supply Chains

Masterbatch demand, customers, and drivers

Forecasted Middle East masterbatch market 2024-2029 (\$MM)



Typical customers in KSA

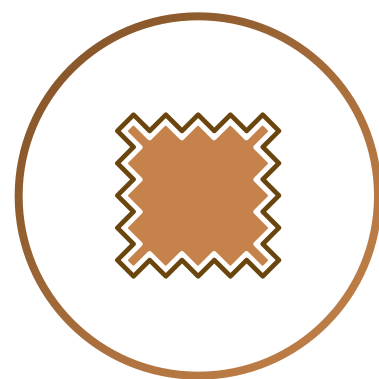
-  Oil & gas players
-  Petrochemical manufacturers
-  Industrial manufacturers

Key KSA demand drivers

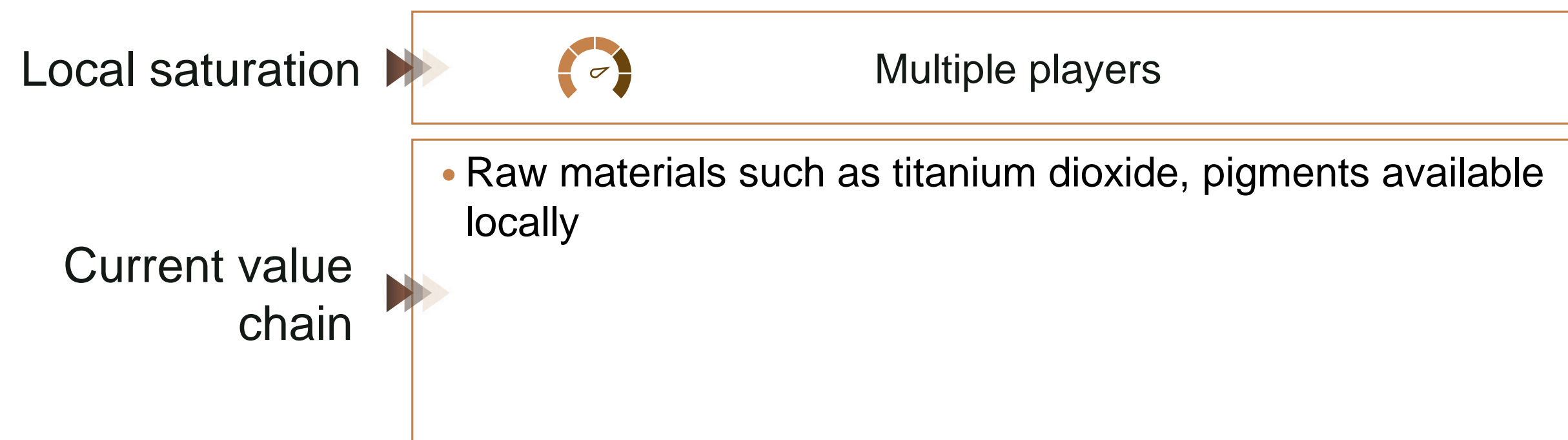
- **Consumer industry demand:** Increased capital expenditure in offshore projects to maintain 12 million bpd of production capacity leading to increase in materials such as flexible pipelines which uses masterbatch as raw material
- **Economic factors:** Industrial diversification and increased production of industrial MFE driving growth for masterbatch used as raw material

Process Chemicals workshop

Value chain and key localization opportunities



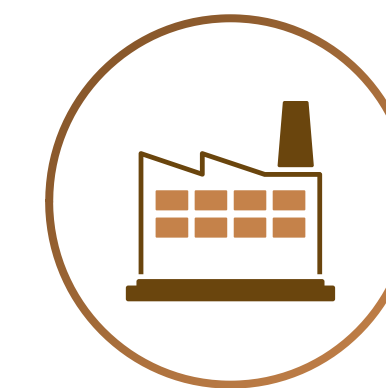
Raw materials



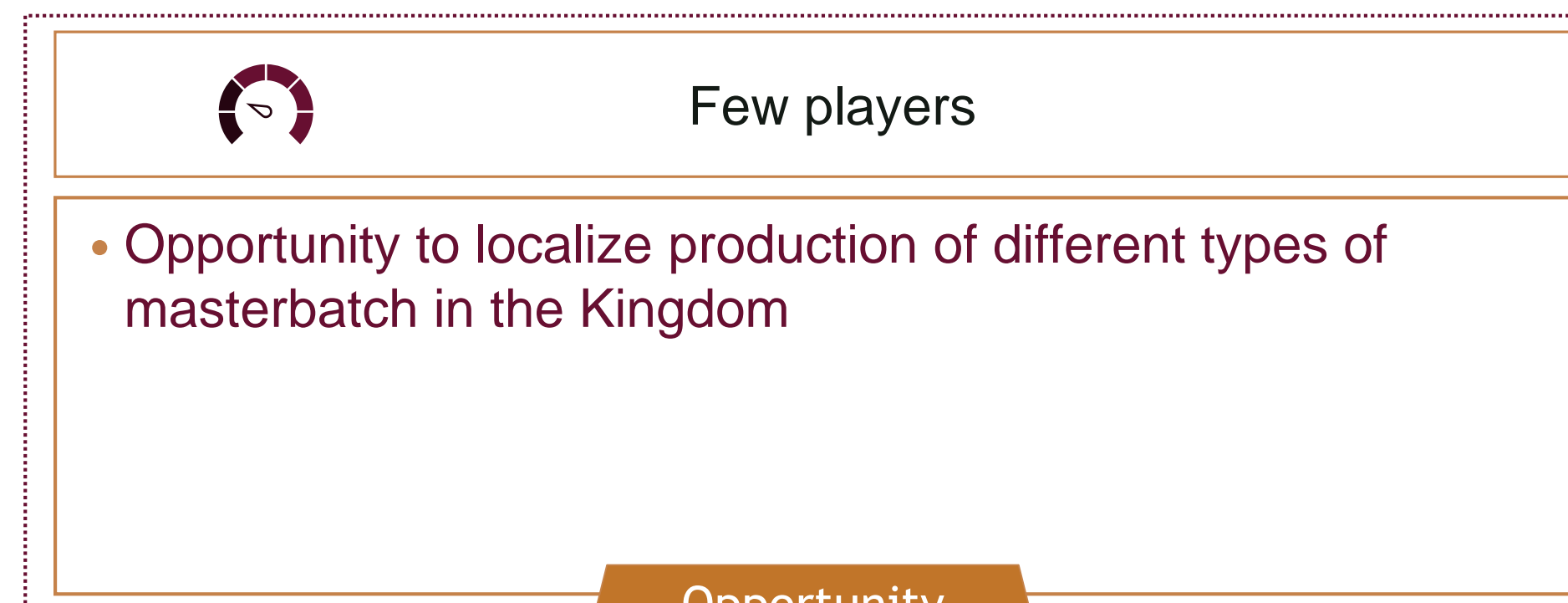
Success factors

Technology

Labor



Product formulation



Opportunity

- Manufacturing technology and quality control systems

- Experienced technicians for plant operations

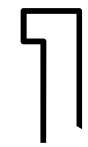
Process Chemicals workshop

Catalyzing Supply Chains

Adipic Acid

Business Opportunity

Opportunity profile



Growing need for adipic acid as intermediary in petrochemical and industrial production



Adipic market is expected to show steady growth over the next 5 years



Attractive investment opportunities exist within the value chain

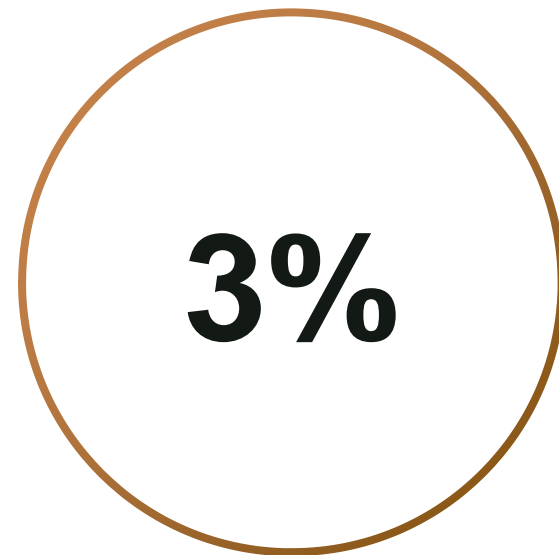
Type(s)

Adipic acid

Specific gravity:
1.36

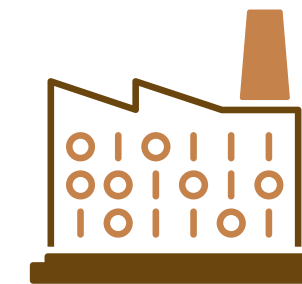


Estimated 2024
KSA market size



Forecasted 5-year
CAGR

KSA value chain opportunities



Product formulation

Technical overview

Adipic acid

General specifications

- Chemical formula: $C_6H_{10}O_4$
- Specific gravity: 1.36
- Form: White crystalline compound

Oil & Gas applications

- Intermediary for production of corrosion inhibitors
- Production of high thermal resistance sealants

Other applications

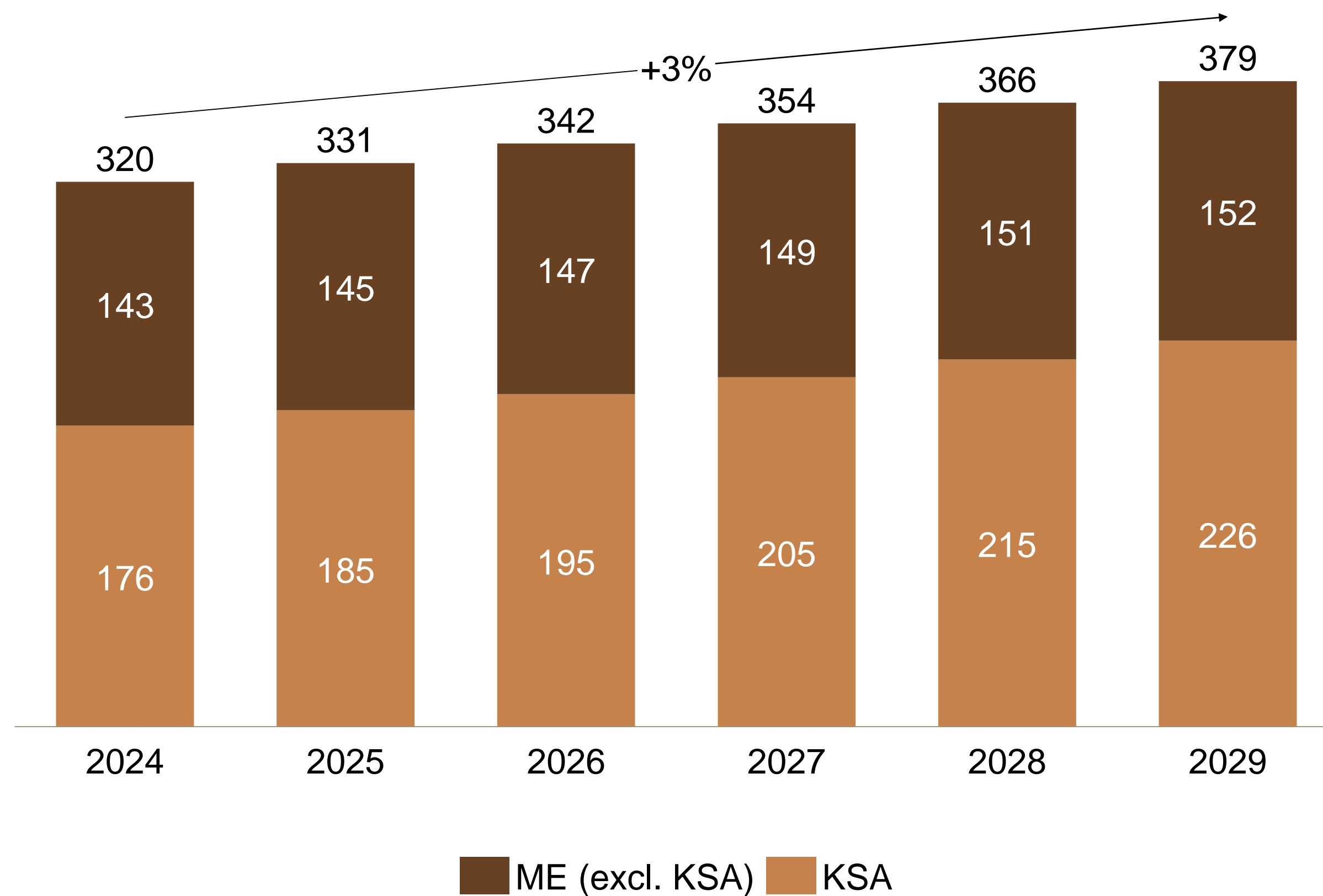
- Production of nylon-6,6¹
- Plasticizers, polyurethane and polyester polyol
- Intermediary for resins used in coatings
- Food additives

Catalyzing Supply Chains




1. Not produced in the middle east; export focused
Source: Expert interviews, team analysis

Adipic acid demand, customers, and drivers

Forecasted Middle East adipic acids market 2024-2029 (\$MM)



Typical end - customers in KSA

-  Oil & gas players
-  Petrochemical manufacturers
-  Industrial manufacturers

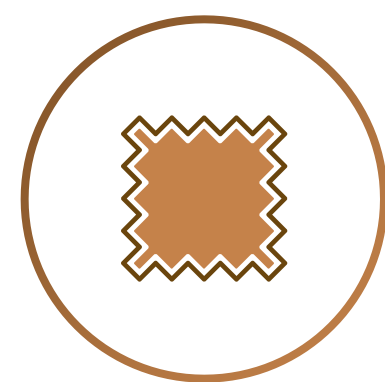
Key KSA demand drivers

- **Consumer industry demand:** Increased upstream production leading to increased demand for adipic acid used as raw materials for corrosion inhibitors and sealants
- **Economic factors:** Industrial diversification and increased production of polymers and chemical MFE driving growth for adipic acid as raw material

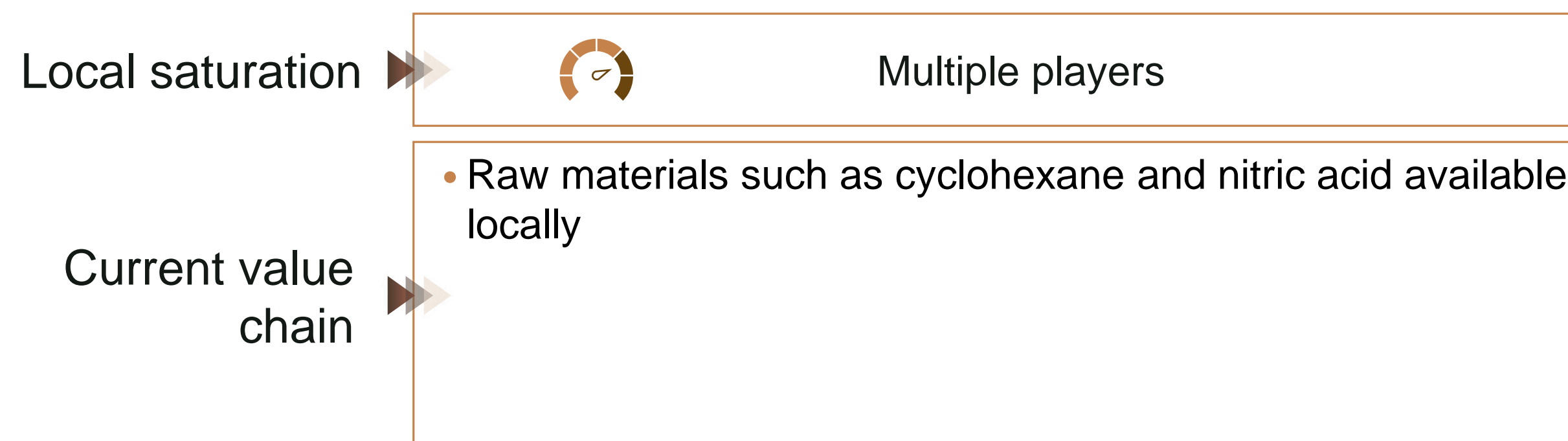
Process Chemicals workshop

Catalyzing Supply Chains

Value chain and key localization opportunities



Raw materials



Success factors

Technology 

Labor 



Product formulation



- License foreign technology and machinery for nitric acid oxidation

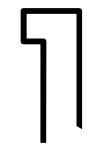
- Experienced technicians with knowledge on adipic acid production

Catalyzing Supply Chains

**CO₂ removal agents
for CCUS**

Business Opportunity

Opportunity profile



KSA is in high need of CO₂ removal agents to meet their carbon neutrality goals as part of Vision 2030

Type(s)

CO₂ adsorbents

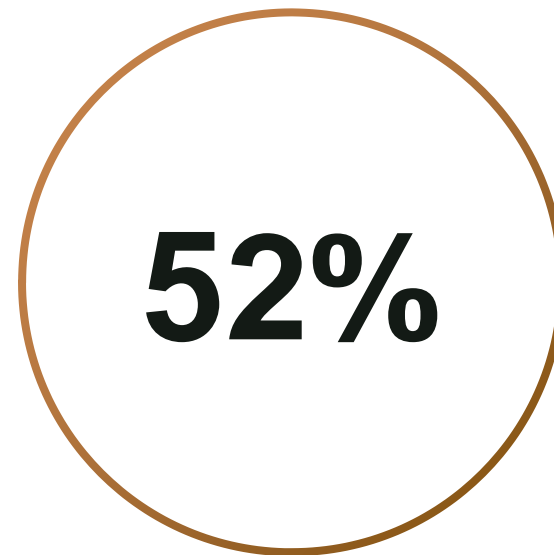
CO₂ absorbents



CO₂ removal market is niche with significant growth expected



Estimated 2024 KSA market size

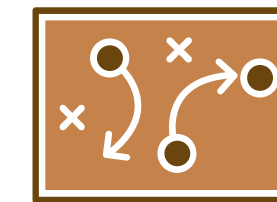


Forecasted 5-year CAGR

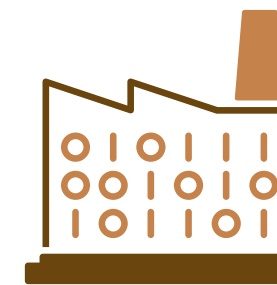


Attractive investment opportunities exist within the value chain

KSA value chain opportunities



Intermediate process



Product formulation

Technical overview

CO₂ adsorbents

General specifications

- Types: Metal organic frameworks, activated carbon, amine functional materials



Applications

- Carbon capture systems
- Enhanced oil recovery
- Gas separation and purification
- Direct air capture
- Air and water purification

Catalyzing Supply Chains

CO₂ absorbents

General specifications

- Types: Potassium carbonate, amino acid liquids

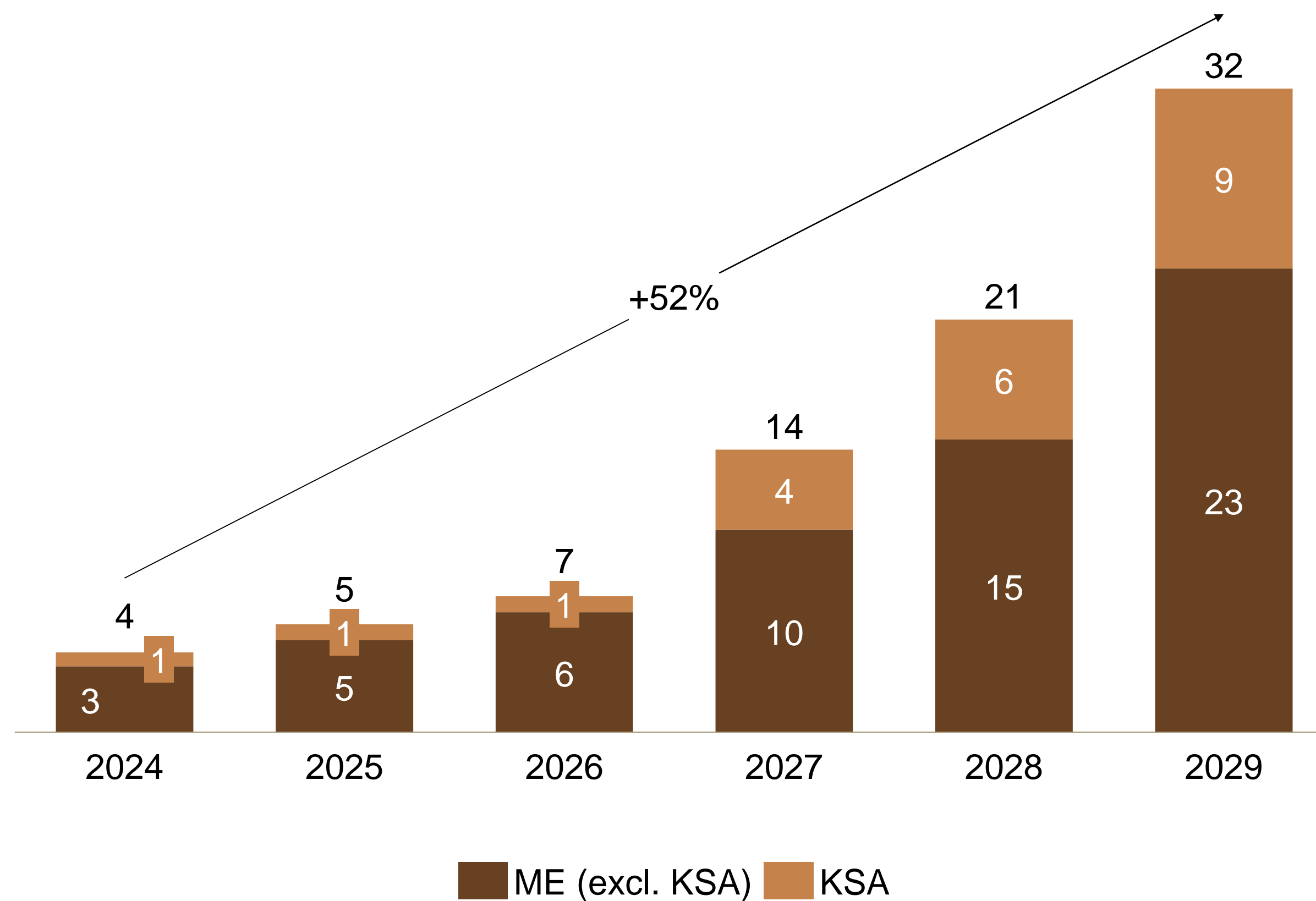


Applications

- Mobile carbon capture technology agent
- Enhanced oil recovery
- Feedstock purification and natural gas sweetening
- Equipment and machinery protection

CO₂ removal agents demand, customers, and drivers

Forecasted GCC CCUS market 2024-2029 (\$MM)



Typical customers in KSA



Oil & Gas players



Petrochemical manufacturers



Power generation

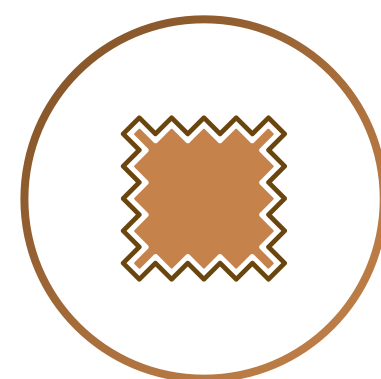
Key KSA demand drivers

- **Consumer industry demand:** Long term strategy of Saudi Aramco to achieve net-zero scope 1 and 2 emissions
- **Sustainability and economic factors:** Growth in CCUS technology as part of national commitments towards CO₂ capture

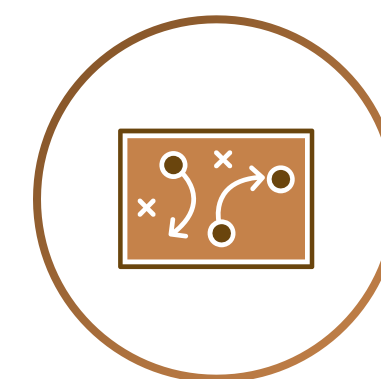
Catalyzing Supply Chains

Note: Market forecast based on the current pledges and plans for CO₂ absorption and adsorption technology
Source: Center on Global Energy Policy Columbia, Global GCC Institute, expert interviews, team analysis

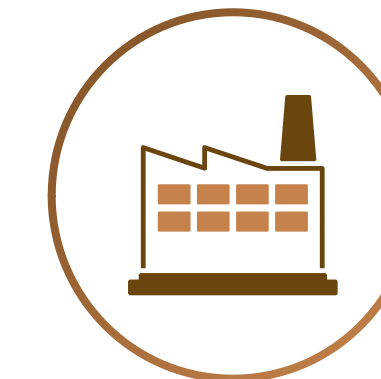
Value chain and key localization opportunities



Raw materials



Intermediate process



Product formulation

Local saturation



Multiple players

Current value chain



- Raw material such as potassium chloride, ammonia, silica and bauxite available locally



Mixed players

- Ethylene amines available locally
- Opportunity to localize potassium bicarbonate /citrate and amino acids



Few players

- Opportunity to localize production of CO2 removal agents

Opportunity

Opportunity

Success factors

Technology



- Reaction control systems

- High throughput experimentation facilities

Labor



- Technicians with expertise in chemical processing

- Engineers with expertise in chemical formulation

Process Chemicals workshop

Catalyzing Supply Chains

CCS additives

Business Opportunity

Technical overview

CCS additives

General specifications

- Key categories: Specialty corrosion inhibitors, solvent stabilizers

CCS applications

- Enhance solvent shelf life
- Corrosion prevention from acidic by-products
- Foaming control for solvents

Other applications

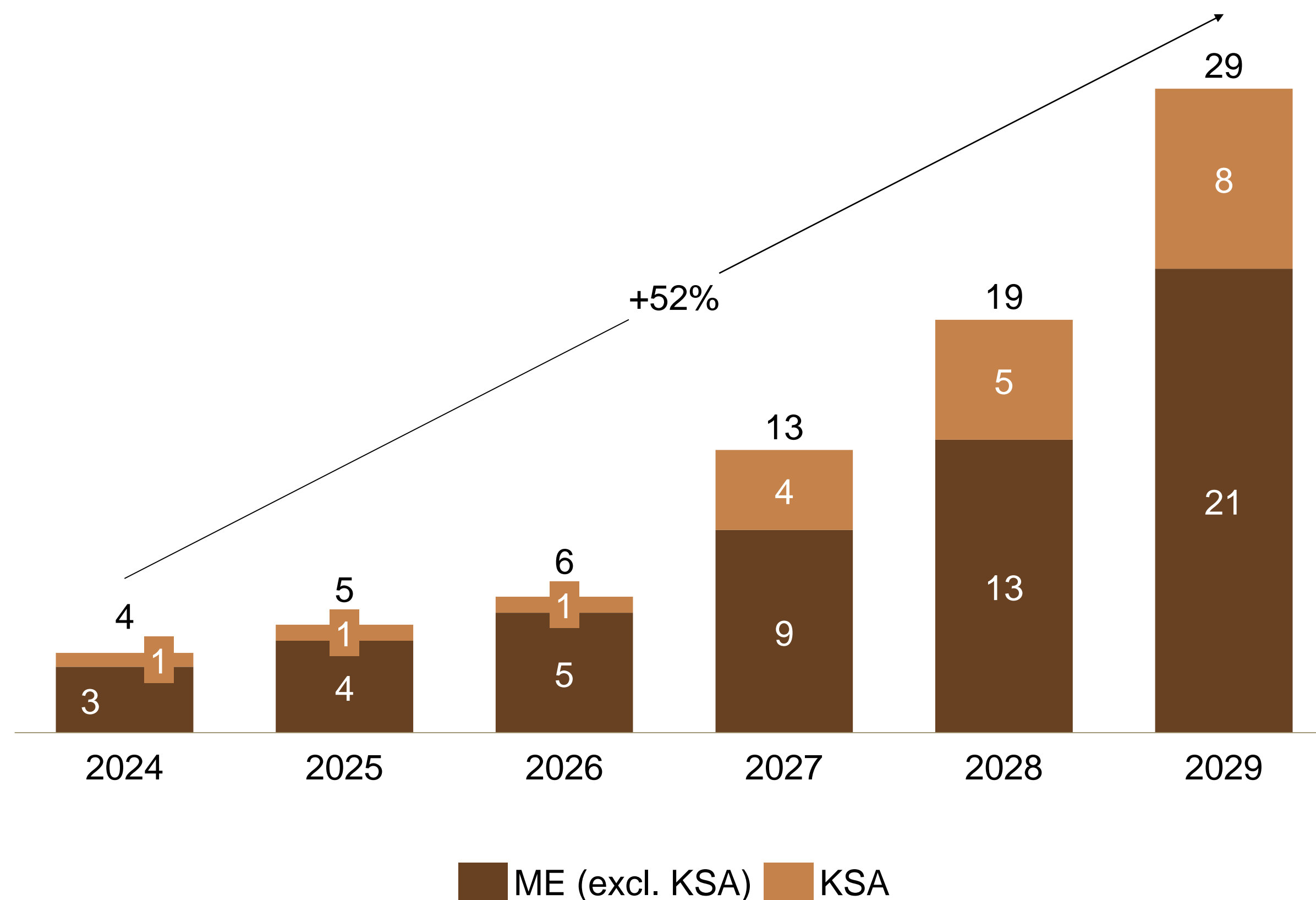
- Pipeline and refinery equipment protection
- Stabilizers for polymer production
- Improves viscosity in paints and coatings

Catalyzing Supply Chains



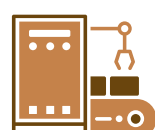
Notes: CCS = Carbon capture and storage
 Source: Expert interviews, Saudi Aramco analysis, team analysis

CCS additives demand, customers, and drivers

Forecasted GCC CCS market 2024-2029 (\$MM)



Typical customers in KSA

-  Oil & Gas players
-  Petrochemical manufacturers
-  Industrial manufacturers

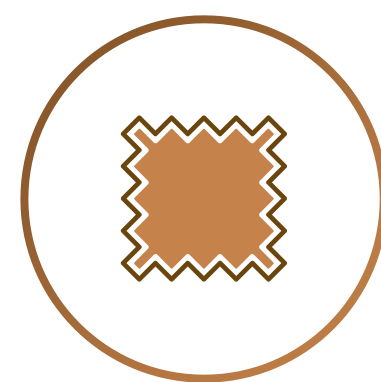
Key KSA demand drivers

- **Consumer industry demand:** Long term strategy of Saudi Aramco to achieve net-zero scope 1 and 2 emissions
- **Sustainability and economic factors:** Growth in CCUS technology as part of national commitments towards CO2 capture

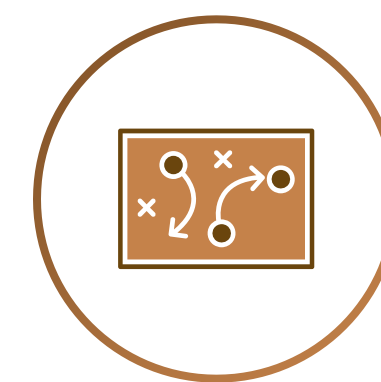
Catalyzing Supply Chains

Note: Market forecast based on the current pledges and plans for CO2 absorption and adsorption technology
Source: Center on Global Energy Policy Columbia, Global GCC Institute, expert interviews, team analysis

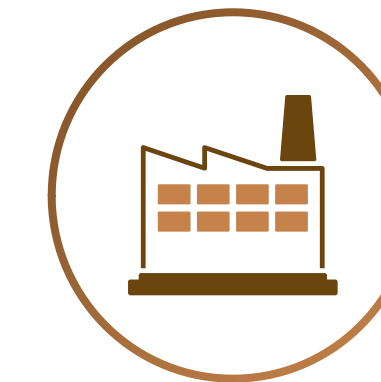
Value chain and key localization opportunities



Raw materials



Intermediate process



Product formulation

Local saturation

▶▶▶ Multiple players

▶▶▶ Multiple player

▶▶▶ Few players

Current value chain

▶▶▶

- Raw material such as amines, phosphates available locally

▶▶▶

- Availability of resources for the synthesis of ethanolamine and the production of biocides locally

▶▶▶

- Opportunity to locally produce specialty corrosion inhibitors, biocide, and solvent stabilizers

Opportunity

Success factors

Technology ▶▶▶

Labor ▶▶▶

▶▶▶

- Advanced chemical formulation tools

▶▶▶

- Chemical engineers with expertise in formulations

Process Chemicals workshop

Catalyzing Supply Chains

**Thank
You**