

Sadara Investment Opportunities

Downstream Chemical and Petrochemical Industries

About Sadara

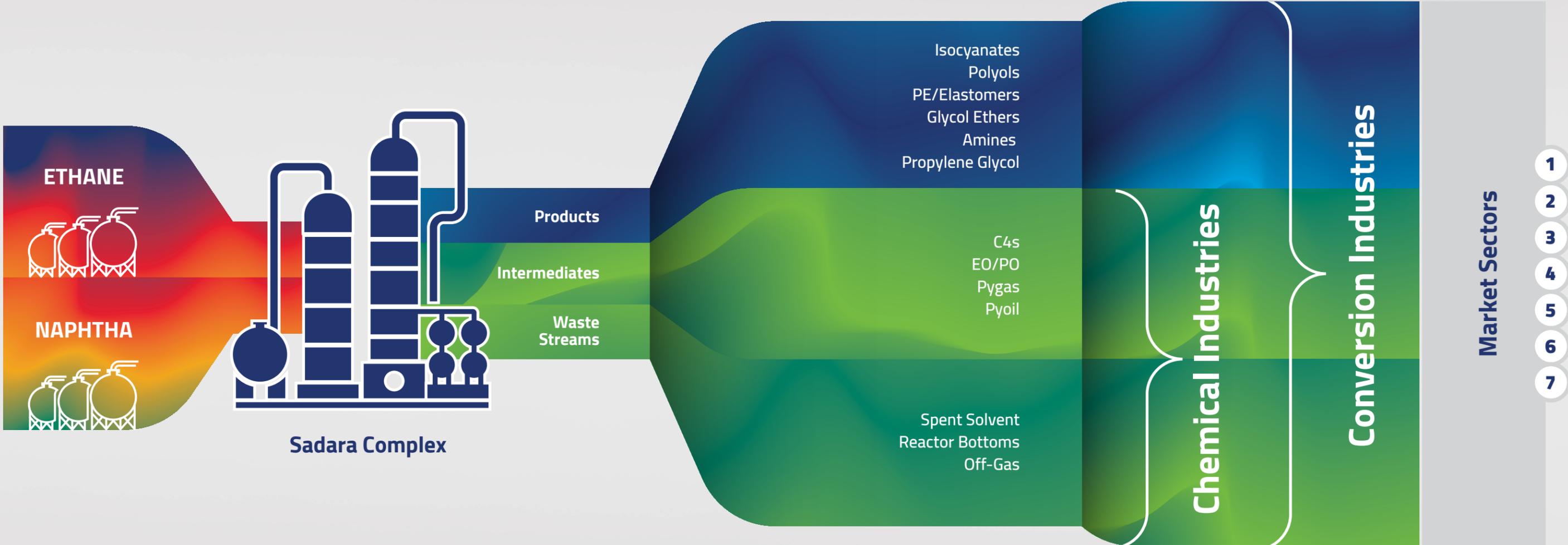
Established in 2011, Sadara Chemical Company is a joint venture developed by Saudi Aramco and The Dow Chemical Company, representing a multi-billion-dollar world-scale chemical complex located in Jubail Industrial City II in Saudi Arabia's Eastern Province.

Comprised of 26 world-scale manufacturing units, the Sadara chemical complex is the world's largest ever built in a single phase, producing more than 3 million tons of plastics and chemicals annually, and is the only chemical company in the Middle East to use refinery liquids, such as naphtha, as feedstock.

Being fully operational in September 2017 and using best-in-class technologies to crack refinery liquid feedstock along with ethane gas, Sadara enables many industries that either currently do not exist in Saudi Arabia or only exist through imports of raw materials.



Sadara Product Portfolio



Automotive Industry Applications
1

Paints & Coatings
2

Water / Power / Oil & Gas Chemicals
3

Consumer Goods & Appliances
4

Construction Chemicals / Products
5

Home & Personal Care
6

Medical Applications
7

About Jubail PlasChem Park

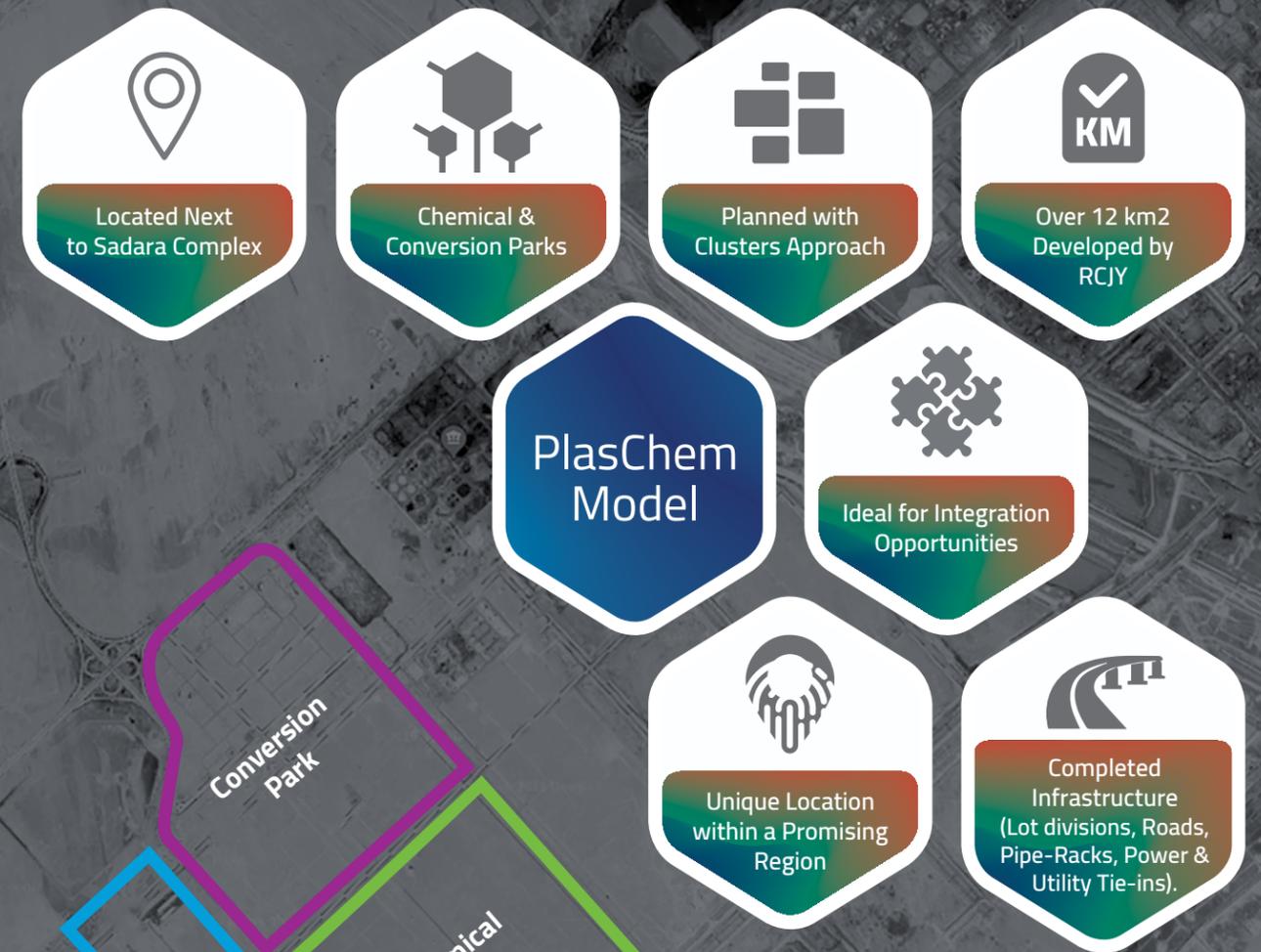
PlasChem Park is a 12-square-kilometer site in Jubail Industrial City II, located next to Sadara's new manufacturing complex and devoted exclusively to chemical and conversion industries that make direct or indirect use of Sadara's products and raw materials from other suppliers.

The PlasChem Park initiative, a collaborative effort by Sadara and the Royal Commission for Jubail and Yanbu (RCJY), will contribute to local economic growth by creating jobs, reducing imports and enhancing the value of Saudi exports. This effort is fully aligned with the Kingdom's Vision 2030.

PlasChem Park consists of two main sections: the Chemical Park and the Conversion Park. To date, PlasChem has already attracted many chemical players and some conversion investors.

PlasChem Park is a key concept differentiating Sadara from other petrochemical, chemical and plastics manufacturing projects in Saudi Arabia.

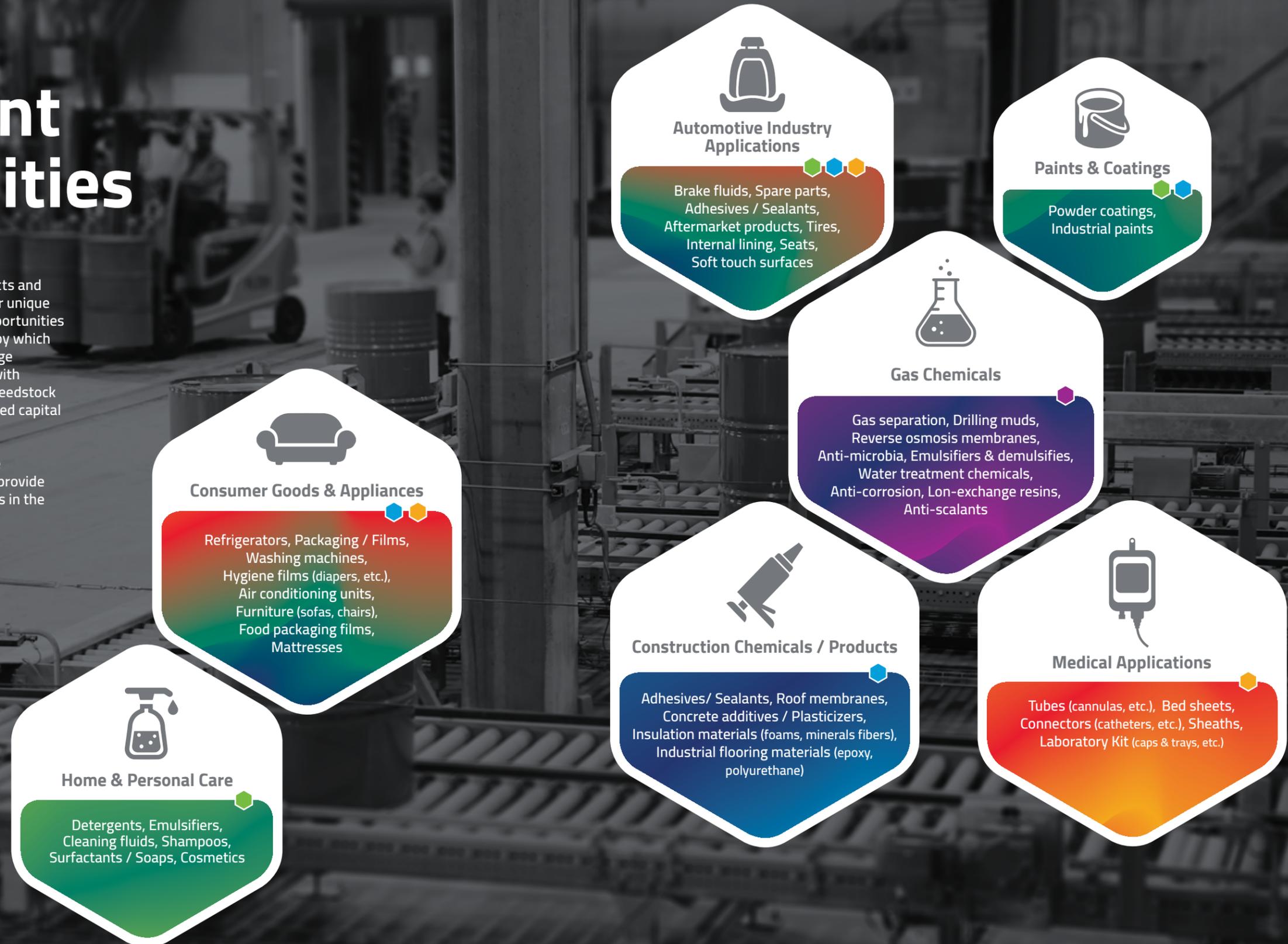
This is due to the large number of downstream opportunities the facility creates through its diverse product applications portfolio and accessibility of feedstock from Sadara and others. The clustering of related chemical process plants provides synergies from shared services and specialist contractors in Jubail. The opportunity the park provides for strong downstream chemical growth creates a perfect breeding ground for industrial diversification and economic transformation.



Sadara Investment Opportunities

With its unique combination of people, products and partners, Sadara catalyzes a variety of further unique chemical and downstream manufacturing opportunities throughout different sectors in the Kingdom by which you can secure your real competitive advantage through the strategic geographical location (with growing economies at your doorstep), direct feedstock supply, existing available resources and reduced capital footprint!

Sadara offers investment opportunities in the production of key chemicals and polymers to provide raw materials for the manufacture of products in the following end-use market sectors:



Sadara is currently offering priority investment opportunities in these four main clusters:

Cluster 1

POLYURETHANE APPLICATIONS

- Polyurethane Systems House
- Polyurethane Insulation Foams



TARGET MARKET SECTORS

- Consumer Goods and Appliances
- Paints & Coatings
- Construction Chemicals/Products

Cluster 2

CHEMICALS FOR PAINTS, COATINGS, SOLVENTS & CLEANING PRODUCTS

- Butyl Glycol Ether Esters (BGE Esters)
- Propylene Glycol Ethers (PGE)
- Propylene Glycol Methyl Ethers (PGME)
- Isopropanolamines



TARGET MARKET SECTORS

- Paints & Coatings
- Home & Personal Care

Cluster 3

CHEMICAL INTERMEDIATES

- MDEA Chemical for Gas Treatment
- DMEA & Derivative Chemicals for Water Treatment and other applications
- Ethyleneamines Derivatives



TARGET MARKET SECTORS

- Water, Power, Oil & Gas Chemicals

Cluster 4

POLYMERS APPLICATIONS

- Polymer moulding & extrusion for Medical, Pharmaceutical and Cosmetic disposables



TARGET MARKET SECTORS

- Medical Applications

Cluster 1

Polyurethane (PU) Applications

PU Systems House (Formulation Development)

Product / Target Market Overview

Recognizing that the formulation of polyurethanes is critical to their successful use in products, polyurethane producers have invested in Formulators or Systems Houses. The main role of the systems houses is to provide customized formulations to customers, as well as to help drive growth by developing polyurethane formulations for new and emerging markets.

APPLICATIONS:

Furniture: This includes bedding, carpet underlay, cushioning material for upholstered furniture, which serve important functions including comfortability and durability

Automotive: Seats, armrests, doors, headrests, interior & exterior of cars, and also where protection against the heat and noise of the engine is required. PU is used for cushion overlay (fabric backing), carpet backing, door panels, sound absorption and vibration dampening, dashboards, steering wheels, bumpers, energy absorbers, headliners, airbag covers and

window encapsulation.

Packaging: Packaging of items that are fragile, delicate and susceptible to scratching, such as LCD and plasma TV panels. It can also be used in transporting of heat-sensitive products in extreme temperatures and/or over long distances with complete control over the cold chain.

Construction: PU is considered for insulation, roofing, windows, doors, floors, OSB (Oriented Strand Board) and MDF (Medium Density Fibreboard) sheets, as well as waterproof protective coatings. Considered for commercial, residential and industrial construction.

CASE (Coatings, Adhesives Sealants, Elastomers): Coatings includes industrial, plastics coatings, general assembly, footwear, and others. Polyurethane elastomers can be used virtually everywhere e.g. Wheels for shopping carts, skateboards etc.

Function: Systems houses provide a wide range of formulations

for flexible, rigid and semi-rigid foams, integral skin coverings, plus other products for coating, adhesive, sealant and elastomer's. Depending on the desired end-product, systems houses prepare chemical formulations consisting of diisocyanates, polyols and other ingredients such as catalysts, blowing agents and flame-retardants.

Polyurethane (PU) Applications

PU Insulation Foam

Product / Target Market Overview (Contd.)

PU Insulation Foam has outstanding thermal insulation properties. It includes both open and closed cell types. All three types, namely flexible, rigid and spray foam, are used for the below mentioned applications.

Global PU Foam Insulation market demand is 2.5 million tons in 2017 and is expected to reach 3.5 million tons by 2027, supported by a CAGR of 3.5 % during the forecast period 2018 to 2027. The estimated (2017) annual value for PU foam US\$ Billion for the volume numbers: KSA 0.21, Middle East 0.59 & Global 12.02.

UAE and Saudi Arabia are among the World's largest markets for insulation materials used in the oil and gas industries. Due to changes in building and construction regulations, thermal and fireproof PU foam insulation is driving double-digit annual growth.

APPLICATIONS:

Construction:

- Applications of PU Foam as an insulator as well as acoustic enhancer in buildings is considered within this segment.
- Key applications of PU Foam considered within construction segment include its utilization in foundation walls, ceiling structures, walls, corners, windows, interior doors, garage doors and roofs.
- PU insulated sheathing, which is applied to studs, sills, plates and header construction, as well as in walls, is also included in the study.

Automotive: Cushioning in seats, armrests and headrests, interior headliner ceiling section, spoilers, doors, , bumpers and cushioned instrument panels

Aerospace: Core material in panels, seat backs, rigid support components, load floors, dashboard, antenna housing, head liners, doors and others

Electronics: Conductive or insulation material

Oil & Gas: Rigid polyurethane foam used to insulate and protect oil & gas pipelines as well as storage & shipping containers

Function: Thermal and acoustic insulation
Key Advantages: Highly cost effective thermal and acoustic insulation.

Polyurethane (PU) Systems House

Typical Plant Scale for Mixed Market Segment Formulations



Opportunity Description

Investment is a generic systems house converting isocyanates and polyols to polyurethane formulations (raw materials) for a broad range of suppliers to furniture, automotive, construction and CASE.



CAPACITY

25,000 to **30,000** Tons per year



TECHNOLOGY

Licensor's or JV partner is required from global providers. Formulation and application knowledge is the key differentiator.



KEY RAW MATERIALS

Isocyanates (MDI/TDI)	Sadara
Polyols (Typically polyether or polyester polyols)	Sadara and other suppliers in the GCC.
Additives (Blowing agents, catalysts, emulsifiers, surfactants, etc.)	Local production of additives is generally limited, but they are available in Kingdom through imports.
KSA Availability	50-90% (formulation dependant)
Sadara Availability	10-90% (formulation dependent)



DIRECT EMPLOYMENT

30-50



INVESTMENT RATIONALE

Import replacement and market growth.



APPLICATION USE

100% in each of the various end-uses.



PRODUCT CHEMISTRY

A combination of Isocyanates, polyols (typically polyether or polyester polyols) and further additives depending on the specific purpose. Systems houses are businesses which purchase liquid chemicals from major producers such as Sadara, mix formulations with other chemicals and re-sell to their own customers. They do not manufacture PU products, but act as intermediary suppliers to sectors of the market that require dedicated or specialist levels of service.



CAPEX

\$35-40 million OSBL 12%



GLOBAL, MIDDLE EAST & KSA ANNUAL MARKET DEMAND

Global, Middle East & KSA Demand (2017)

5.1 Million Tons (Global)
335,000 Tons (Middle East)
107,000 Tons (KSA)

Global, Middle East & KSA Growth Rate (2018-2027)

3.8% CAGR Global
4.0% CAGR Middle East
3.8% CAGR KSA

Value US\$ Billion for the Volume Numbers

5.21 Global
0.19 Middle East
0.11 KSA

Polyurethane (PU) Systems House

Plant for Mixed Market Segment Application Formulations or Single Market Segment Formulations (e.g., CASE)



Opportunity Description

Investment in a specialised systems house converting isocyanates and polyols to polyurethane formulations (raw materials) for a specific end-use sector e.g. CASE.



CAPACITY

8,000 to **10,000** Tons per year



TECHNOLOGY

Licensor's or JV partner is required from global providers. Formulation and application knowledge is the key differentiator.



KEY RAW MATERIALS

Isocyanates (MDI/TDI)	Sadara
Polyols (typically polyether or polyester polyols)	Sadara and other suppliers in the GCC.
Additives (Blowing agents, catalysts, emulsifiers, surfactants, etc.)	Local production of additives is generally limited, but they are available in Kingdom through imports.
KSA Availability	50-90% (formulation dependant)
Sadara Availability	10-90% (formulation dependent)



DIRECT EMPLOYMENT

25-45



INVESTMENT RATIONALE

Import replacement.



APPLICATION USE

100% in each of the various end-uses.



PRODUCT CHEMISTRY

A combination of Isocyanates, polyols (typically polyether or polyester polyols) and further additives depending on the specific purpose. Systems houses are businesses which purchase liquid chemicals from major producers such as Sadara, mix formulations with other chemicals and re-sell to their own customers. They do not manufacture PU products, but act as intermediary suppliers to sectors of the market that require dedicated or specialist levels of service.



CAPEX

\$8-10 million OSBL 30%



GLOBAL, MIDDLE EAST & KSA ANNUAL MARKET DEMAND

PU CASE FORMULATION APPLICATIONS

Global, Middle East & KSA Demand (2017)

1 Million Tons (Global)
29,500 Tons (Middle East)
16,000 Tons (KSA)

Global, Middle East & KSA Growth Rate (2018-2027)

2.5% CAGR Global
1.8% CAGR Middle East
3.3% CAGR KSA

Value US\$ Billion for the Volume Numbers

5.21 Global
0.19 Middle East
0.11 KSA

Polyurethane Insulation Foam

Combination Plant for Boards, Blocks, Sheets and Spray



Opportunity Description

Investment in a plant converting MDI and polyether polyols to produce rigid insulation foams and also the raw materials for spray insulation, supplying consumer goods, construction, automotive manufacturers.



CAPACITY

3 million m² per year



TECHNOLOGY

Licensor's or JV partner is required from global providers.



KEY RAW MATERIALS

MDI	Sadara
Polyether Polyols	Sadara and other suppliers in the GCC
Blowing agents (e.g. pentane, HFC, cyclopentane)	Local production of additives is generally limited, but they are available in Kingdom through imports.
KSA Availability	50-80% (formulation dependant)
Sadara Availability	50-80% (formulation dependent)



DIRECT EMPLOYMENT

100-120



INVESTMENT RATIONALE

Logistics advantages for key raw materials and finished products over imports.



APPLICATION USE

100% in insulation products.



PRODUCT CHEMISTRY

MDI, polyether polyols and additives such as blowing agents, catalysts, stabilisers and flame retardants.



CAPEX

\$25-30 million OSBL 17%



GLOBAL, MIDDLE EAST & KSA ANNUAL MARKET DEMAND

Global, Middle East & KSA Demand (2017)

2.5 Million Tons (Global)
235,000 Tons (Middle East)
60,000 Tons (KSA)

Global, Middle East & KSA Growth Rate (2018-2027)

3.5% CAGR Global
3.7% CAGR Middle East
4.2% CAGR KSA

Value for PU Foam US\$ Billion for the Volume Numbers

12.02 Global
0.59 Middle East
0.21 KSA

Cluster 2

Chemicals for Paints, Coatings, Solvents & Cleaning Products

PGE, Isopropanolamine and BGE, PGME Esters

Product / Target Market Overview

Solvents are used in a wide variety of applications, from paints, coatings and inks to dry cleaning, adhesives and personal care. Due to the variety of processes, products and chemical applications that they are used in, there is a significant variety of chemicals that can be used as a solvent, with different chemical types catering to different end-markets.

BUTYL GLYCOL ETHER ESTERS (BGE ESTERS): These are mainly used as solvents in paints and coatings; they are also used in metal and household cleaners. The BGE Esters derivatives plant produces multiple grades of liquid derivatives including butoxy glycol ether, butoxy diglycol ether, butoxy tri glycol ether and butoxy poly glycol ether.

PGE are commonly used as coupling agents in paints and as solvents and are also materials for producing coatings, resins, inks and cleaners. Compared to ethylene glycol ethers, propylene glycol ethers offer coupling advantages, low toxicity, increased electrolyte solubility and excellent wetting ability.

Applications:

- Dye solvents in the textile, leather and printing industries
- Solvents for grease and grime in industrial cleaning and specialty formulations
- Solvents for insecticides and herbicides for agricultural applications
- Coupling solvents for hard-surface cleaners and other soap-hydrocarbon systems
- Solvents and cosolvents for conventional lacquer, enamel and stains for industrial coating systems
- Cosolvents for waterborne industrial coating systems
- Fuel System Icing Inhibitor (FSII)
- Freeze-thaw agents in aqueous systems
- Chemical reaction solvents

PROPYLENE GLYCOL ETHERS (PGE): These have a very broad end-use market and are mainly used for paints & coatings and intermediates. They are also used in printing inks, electronics, cleaner fluids, etc.

Product / Target Market Overview (Contd.)

PGEs are high-performance solvents used in numerous industrial applications, including cleaners, inks, paints and coatings. Other uses and applications for PGE include agricultural, cosmetic, electronic, ink, textile and adhesive products.

Across the globe, shifting preference toward the use of biodegradable, sustainable and low VOC content paints & coating products in several end-use industries such as automotive, printing ink, and fabrication, among others, has heightened demand for eco-friendly solvents in the recent past. This rise in demand for eco-friendly solvents is a major driving factor for the propylene glycol methyl ether market.

Usage:

- Active and tail solvent for solvent-based gravure and flexographic printing inks
- Coupling agent in solvent blends for water-based gravure, flexographic and silk-screen printing inks
- Carrier solvent for ball point and felt tip writing pen inks
- Coupling agent and solvent for household and industrial cleaners, rust removers and hard surface cleaners
- Solvent for agricultural pesticides, deactivator and emollient for livestock pesticides
- Resin manufacturers, coating formulators and coating applicators for the manufacturing of protective paint & coatings for applications in automotive, architecture and other industrial applications (e.g., on-shore and off-shore oil & gas industries)

PROPYLENE GLYCOL METHYL ETHERS (PGME): These are mainly used as solvents with focus on cleaners and chemical intermediates for the manufacturing of glycol ether acetate. PGME is the fastest evaporating solvent in the Glycol Ether family. Within the mono-propylene glycol ether segment, the methyl ether, known as PGME, is the product most in demand.

Usage:

- A range of acetates can be produced by reacting the glycol ethers with acetic acid, and a significant use of PGMEs are as an intermediate in the production of the methyl ether acetate (PGMEA).
- Can also be used in combination with Propylene Glycol n-Butyl Ether (PnB) glycol ether in glass cleaning formulations.
- Active and tail solvent for solvent-based gravure and flexographic printing inks
- Coupling agent in solvent blends for water-based gravure, flexographic and silk-screen printing inks
- Carrier solvent for ball point and felt tip writing pen inks
- Coupling agent and solvent for household and industrial cleaners, rust removers and hard surface cleaners
- Solvent for agricultural pesticides, deactivator and emollient for livestock pesticides

ISOPROPANOLAMINES (IPAs): These are used in the chemical industry as a cross-linking agent and curing agent for polymer manufacturing or in paints/plastic coating formulations as a dispersant. They are also used by the household and personal care industry (in detergents and as a foam regulator, thickener, emulsifier or wetting agent).

Isopropanolamines are basic chemicals used in many applications to achieve basicity, buffering and alkalinity objectives. These amines are typically used to neutralize fatty acids and sulfonic acid-based surfactants in the manufacture of soaps and salts. Isopropanolamines are also used in oven cleaners because they are good solubilizers of oil and fat.

Applications:

- Cosmetics and Personal Care Products: Skin cream, lotions, hair sprays and shampoos Textiles, Scouring agents, wetting agents, lubricating agents
- Metalworking Compounds: Buffing, cutting, cleaning fluids
- Agricultural Sprays (Powder and Liquid): Herbicides, algaecides, fungicides, pesticides
- Pharmaceuticals: Antihistamines, antibiotics, local anaesthetics
- Gas Treating: Acid gas scrubbing
- Polymer Manufacturing: Urethanes, rubber and polyolefins

Butyl Glycol Ether Esters (BGE Esters), Propylene Glycol Ethers (PGE), Propylene Glycol Methyl Ethers (PGME) & Isopropanolamine (IPA)

Integrated Plant from Propylene Oxide (PO) & Ethylene Oxide (EO)



Opportunity Description

Investment in a multi-product plant converting EO & PO to a range of solvent chemicals to supply downstream solvent producers and blenders.



CAPACITY

60,000 to **70,000** Tons per year



TECHNOLOGY

Licensor's or JV partner is required from global providers.



KEY RAW MATERIALS

Propylene Oxide	Sadara
Others (ethylene oxide, ammonia, methanol, butanol, phenol)	EO: Sadara Others: Available from multiple manufacturing sites in Saudi Arabia
KSA availability others	20-40% (formulation dependant)
PO Sadara availability	60-80% (formulation dependant)



DIRECT EMPLOYMENT

40-60



INVESTMENT RATIONALE

Import replacement and integration of KSA manufacturing.



APPLICATION USE

Typically 10-80% (formulation dependant).



PRODUCT CHEMISTRY

Propylene oxide derivative.



CAPEX

\$50-80 million ±30% OSBL 25%



GLOBAL, MIDDLE EAST & KSA ANNUAL MARKET DEMAND

Global, Middle East & KSA Demand (2017)

1.76 Million Tons (Global)
171,000 Tons (Middle East)
36,400 Tons (KSA)

Global, Middle East & KSA Growth Rate (2018-2027)

4-5% CAGR

Value US\$ Billion for the Volume Numbers

13.33 Global
1.29 Middle East
0.28 KSA

Isopropanolamine-IPA (From Ammonia & Propylene Oxide)

Stand-Alone Derivatives Plant



Opportunity Description

Investment in a stand alone plant converting PO & ammonia to solvent chemicals to supply paints and coatings and cleaning products manufacturers.



CAPACITY

10,000 to
15,000 Tons per year



TECHNOLOGY

Licensor's or JV partner is required from global providers.



KEY RAW MATERIALS

Propylene Oxide	Sadara
Ammonia	Available from multiple manufacturing sites in Saudi Arabia
KSA availability Ammonia	20-40% (formulation dependant)
PO Sadara availability	60-80% (formulation dependant)



DIRECT EMPLOYMENT

40-60



INVESTMENT RATIONALE

Import replacement and integration of KSA manufacturing.



APPLICATION USE

Typically 0.5-20% (formulation dependant).



PRODUCT CHEMISTRY

PO and Ammonia derivative.



CAPEX

\$25-40 million $\pm 50\%$ OSBL 25%



GLOBAL, MIDDLE EAST & KSA ANNUAL MARKET DEMAND

Global, Middle East & KSA Demand (2017)

60,000 Tons (Global)
11,000 Tons (Middle East)
2,800 Tons (KSA)

Global, Middle East & KSA Growth Rate (2018-2027)

5-7% CAGR

Value US\$ Billion for the Volume Numbers

0.32 Global
0.06 Middle East
0.02 KSA

Propylene Glycol Methyl Ether - PGME (from Propylene Glycol)

Stand-Alone Derivatives Plant



Opportunity Description

Investment in a stand alone plant converting propylene glycol to solvent chemicals to supply paints and coatings and cleaning products manufacturers.



CAPACITY

10,000 to **15,000** Tons per year



TECHNOLOGY

Licensor's or JV partner is required from global providers.



KEY RAW MATERIALS*

Propylene Glycol	Sadara
Others (ethylene oxide, ammonia, methanol, butanol, phenol)	EO: Sadara Others: Available from multiple manufacturing sites in Saudi Arabia
KSA availability others	10-30% (formulation dependant)
PG Sadara availability	70-90% (formulation dependant)



DIRECT EMPLOYMENT

15-25



INVESTMENT RATIONALE

Import replacement and integration of KSA manufacturing.



APPLICATION USE

Typically 1-50% (formulation dependant).



PRODUCT CHEMISTRY

Propylene glycol derivative.



CAPEX

\$25-40 million ±30% OSBL 25%



GLOBAL, MIDDLE EAST & KSA ANNUAL MARKET DEMAND

Global, Middle East & KSA Demand (2017)

900,000 Tons (Global)
55,000 Tons (Middle East)
7,700 Tons (KSA)

Global, Middle East & KSA Growth Rate (2018-2027)

4-5% CAGR

Value US\$ Billion for the Volume Numbers

1.60 Global
0.10 Middle East
0.01 KSA

Propylene Glycol Methyl Ether - PGME (from Propylene Glycol)

Stand-Alone Derivatives Plant



Opportunity Description

Investment in a stand alone plant converting propylene glycol & methanol to solvent chemicals to supply paints and coatings and cleaning products manufacturers.



CAPACITY

10,000 to **15,000** Tons per year



TECHNOLOGY

Licensor's or JV partner is required from global providers.



KEY RAW MATERIALS*

Propylene Glycol	Sadara
Methanol	Available from multiple manufacturing sites in Saudi Arabia
KSA availability Methanol	10-30% (formulation dependant)
PG Sadara availability	70-90% (formulation dependant)

*PGME is normally produced by the reaction of propylene oxide with methanol using a heterogeneous catalyst.



DIRECT EMPLOYMENT

15-25



INVESTMENT RATIONALE

Import replacement and integration of KSA manufacturing.



APPLICATION USE

Typically 1-50% (formulation dependant).



PRODUCT CHEMISTRY

Propylene glycol derivative.



CAPEX

\$25-40 million ±30% - OSBL



GLOBAL, MIDDLE EAST & KSA ANNUAL MARKET DEMAND

Global, Middle East & KSA Demand (2017)

400,000 Tons (Global)
61,000 Tons (Middle East)
16,100 Tons (KSA)

Global, Middle East & KSA Growth Rate (2018-2027)

3-4% CAGR

Value US\$ Billion for the Volume Numbers

0.37 Global
0.06 Middle East
0.01 KSA

Butyl Glycol Ether Esters (BGE Esters)

Stand-Alone Derivatives Plant



Opportunity Description

Investment in a stand alone plant converting BGE to a range of solvent chemicals to supply paints and coatings and cleaning products manufacturers.



CAPACITY

10,000 to
15,000 Tons per year



TECHNOLOGY

Licensor's or JV partner is required from global providers.



KEY RAW MATERIALS

BGE	Sadara
Others (ethylene oxide, ammonia, methanol, butanol, phenol)	EO: Sadara Others: Available from multiple manufacturing sites in Saudi Arabia
KSA availability others	10-30% (formulation dependant)
BGE Sadara availability	70-90% (formulation dependant)



DIRECT EMPLOYMENT

15-25



INVESTMENT RATIONALE

Import replacement and integration of KSA manufacturing.



APPLICATION USE

Typically 10-70% (formulation dependant).



PRODUCT CHEMISTRY

BGE derivative.



CAPEX

\$25-40 million $\pm 30\%$ - OSBL 25%



GLOBAL, MIDDLE EAST & KSA ANNUAL MARKET DEMAND

Global, Middle East & KSA Demand (2017)

400,000 Tons (Global)
44,000 Tons (Middle East)
9,800 Tons (KSA)

Global, Middle East & KSA Growth Rate (2018-2027)

3-4% CAGR

Value US\$ Billion for the Volume Numbers

4.67 Global
0.51 Middle East
0.11 KSA

Cluster 3

Chemical Intermediates

A) Chemicals for Gas and Water Treatment

- Methyldiethanolamine (MDEA) Chemical for Gas Treatment
- Dimethylethanolamine (DMEA) and Derivative Chemicals for Water Treatment and other applications

B) Ethyleneamines Derivatives

A) Chemicals for Gas and Water Treatment

Product / Target Market Overview

DMEA has the following global, major end use applications:

Water Treatment: DMEA is an intermediate consumed in the production of dimethylaminoethyl-(meth)acrylate (DMEAMA), one of the key ingredients for polyacrylamide, a flocculant used in water treatment. Flocculation is the process by which the particles in a dispersion form larger size clusters – this allows for the removal of impurities through filtration. Polyacrylamide flocculants are used in the purification of drinking water, treatment of waste water and sludge dewatering.

Paper and Pulp: Polyacrylamides including DMEA (through DMEAMA) are also widely used in paper manufacture. Flocculants (such as polyacrylamide) are added to the pulp to strengthen bonds formed between cellulose fibres in paper, increasing the dry- and wet-strength properties.

Paints and Coatings: DMEA is used in water-soluble coating-resins, to improve pigment wettability and also as thickening agents. Water-soluble paints and coatings now account for 80 percent of the market, as solvent based products are less favoured due to toxicity issues.

Epoxy Resins: DMEA is utilised as a curing agent for epoxy resins. It also acts as a viscosity reducing agent for resinous polyamides and other viscous hardeners. DMEA is also an extremely good wetting agent for various filters in epoxy formulations.

Polyurethane: Ethanolamines, including DMEA, are utilised as a curing agent in the production of polyurethane foams. The ethanolamine acts as a cross-linker, which increases the rigidity and resilience of the foam, giving a more responsive springy feel to the polyurethane foam. Rigid polyurethane foams provide excellent thermal insulation and as such have a range of applications, including refrigerators and building insulation. Due to the buoyancy of rigid polyurethane foams, they are also used in boats, life preservers and other floatation devices. Dependent on the application and desired rigidity, ethanolamines can constitute 0.5-1.0 percent of PU foams.

Ion Exchange Resins: Anion exchange resins can be prepared from DMEA, through reaction with chloromethylated vinyl or styrene resins. The resins are utilised in separation, purification and decontamination processes, such as water softening and purification. The exact formulation of such resins is proprietary information and as such information on consumption into this application is unavailable.

Boiler Coating: DMEA is widely used as a coating systems to prevent corrosion. Such prevention measures are required in large boiler systems such as those found in refinery and petrochemical plants (for steam production), and as such a large growing market exists for such products within Saudi Arabia and the GCC.

Pharmaceuticals: DMEA has been licensed for use as a drug (Deanol) to treat attention deficit-hyperactivity disorder (ADHD), Alzheimer's disease and autism. It has also been used as a health supplement for increasing energy, athletic performance and concentration.

Water Treatment

The water treatment chemicals industry is a multiplier. The supply chain is composed of chemical producers, chemical formulators and water management service companies. Currently only the formulators and service companies operate in KSA.

Gas Treatment

- The alkanolamine MDEA will absorb carbon dioxide and hydrogen sulphide at lower temperatures and release the acid gases at higher temperatures. This forms the basis of separating the two gases from gas streams.
- Demand for this chemical is driven by oil and gas producing regions such as the Middle East.

B) Ethyleneamines Derivatives

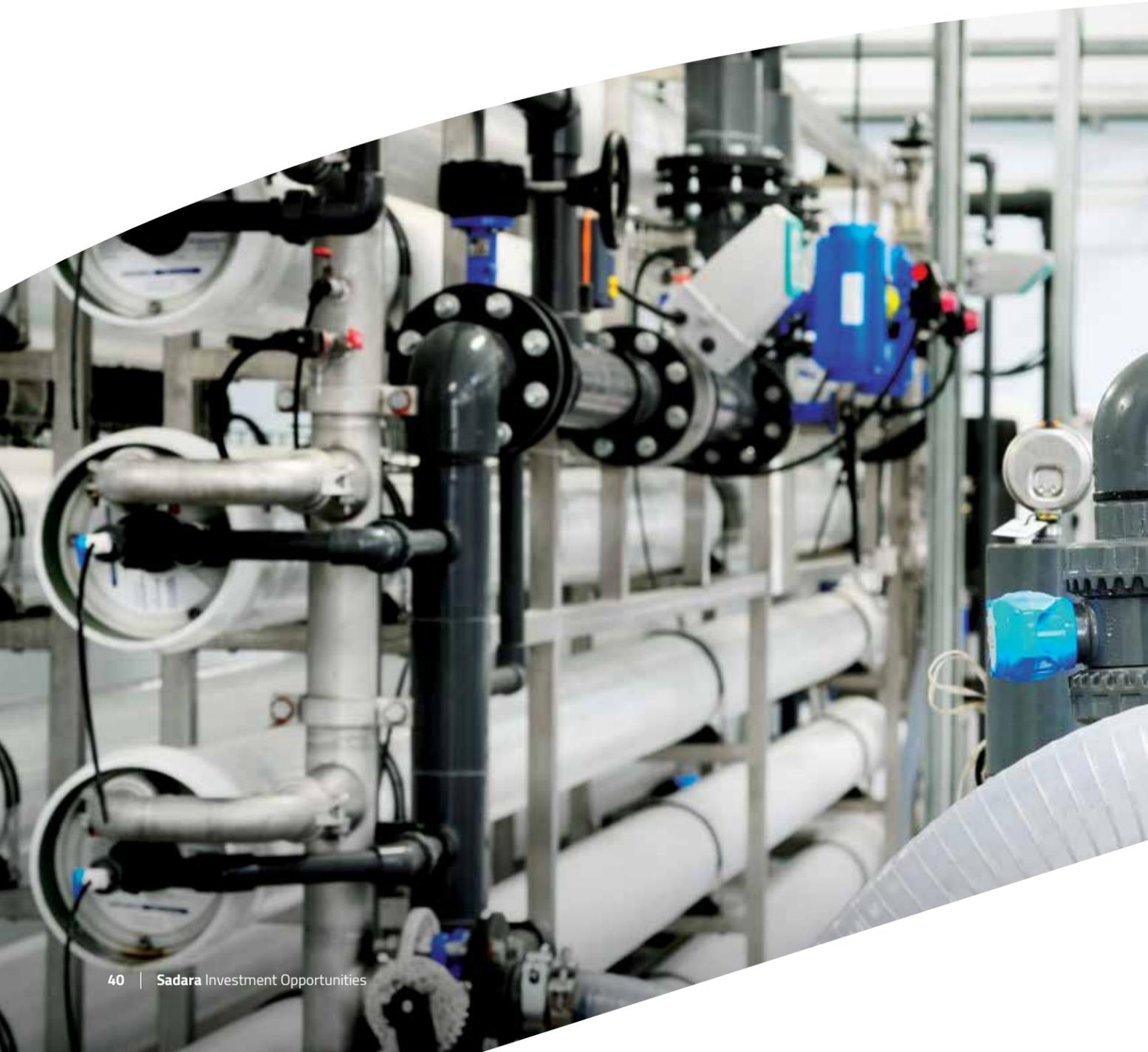
Product / Target Market Overview

Ethyleneamines typically make up critical parts of functional chemicals, surfactants, corrosion inhibitors, polymers and pesticides. Although many uses for ethyleneamines are decades-old, the multifunctional amine chemistry of the ethyleneamines allows many applications to continue to undergo active development.

Function: Depending on the end-market, ethyleneamine derivatives have several functions including lubricant additive (EBS), curing agent for epoxy resin, chelating agent for hard water, fabric softener, oil additive for dirt removal, intermediate for agrochemicals and pharmaceuticals, etc.

A) Chemicals for Gas and Water Treatment

- Methyl diethanolamine (MDEA) Chemical for Gas Treatment
- Dimethylethanolamine (DMEA) and Derivative Chemicals for Water Treatment and other applications



Opportunity Description

An investment in a plant converting EO and ammonia to chemicals for gas and water treatment.



CAPACITY

30,000 Tons / year MDEA
10,000 Tons / year DMEA/DMEAMA



TECHNOLOGY

Licensor's or JV partner is required from global providers.



KEY RAW MATERIALS

Ethylene Oxide	Sadara
Others (Ammonia, Methanol & Methyl methacrylate)	Available from multiple manufacturing sites in Saudi Arabia
KSA availability others	60-70% (formulation dependant)
EO Sadara availability	30-40% (formulation dependant)



DIRECT EMPLOYMENT

25-30



INVESTMENT RATIONALE

Import replacement.



APPLICATION USE

MDEA 30-50% (formulation dependant).
 PAM 10-30% (formulation dependant).



PRODUCT CHEMISTRY

MDEA: Methyl amine and ethylene oxide
 DMEA: Dimethyl amine and ethylene oxide



CAPEX

\$110-160 million ±30% - OSBL 38%
\$7-10 million ISBL for a Polyacrylamide (PAM) plant (required additional process step for water treatment chemicals)



GLOBAL, MIDDLE EAST & KSA ANNUAL MARKET DEMAND

Global, Middle East & KSA Demand (2017)

MDEA
228,000 Tons (Global)
82,000 Tons (Middle East)
18,000 Tons (KSA)

DMEA/DMEAMA
255,000 Tons (Global)
20,000 Tons (Middle East)
6,000 Tons (KSA)

Polyacrylamide
2 Million Tons (Global)
134,000 Tons (Middle East)
48,000 Tons (KSA)

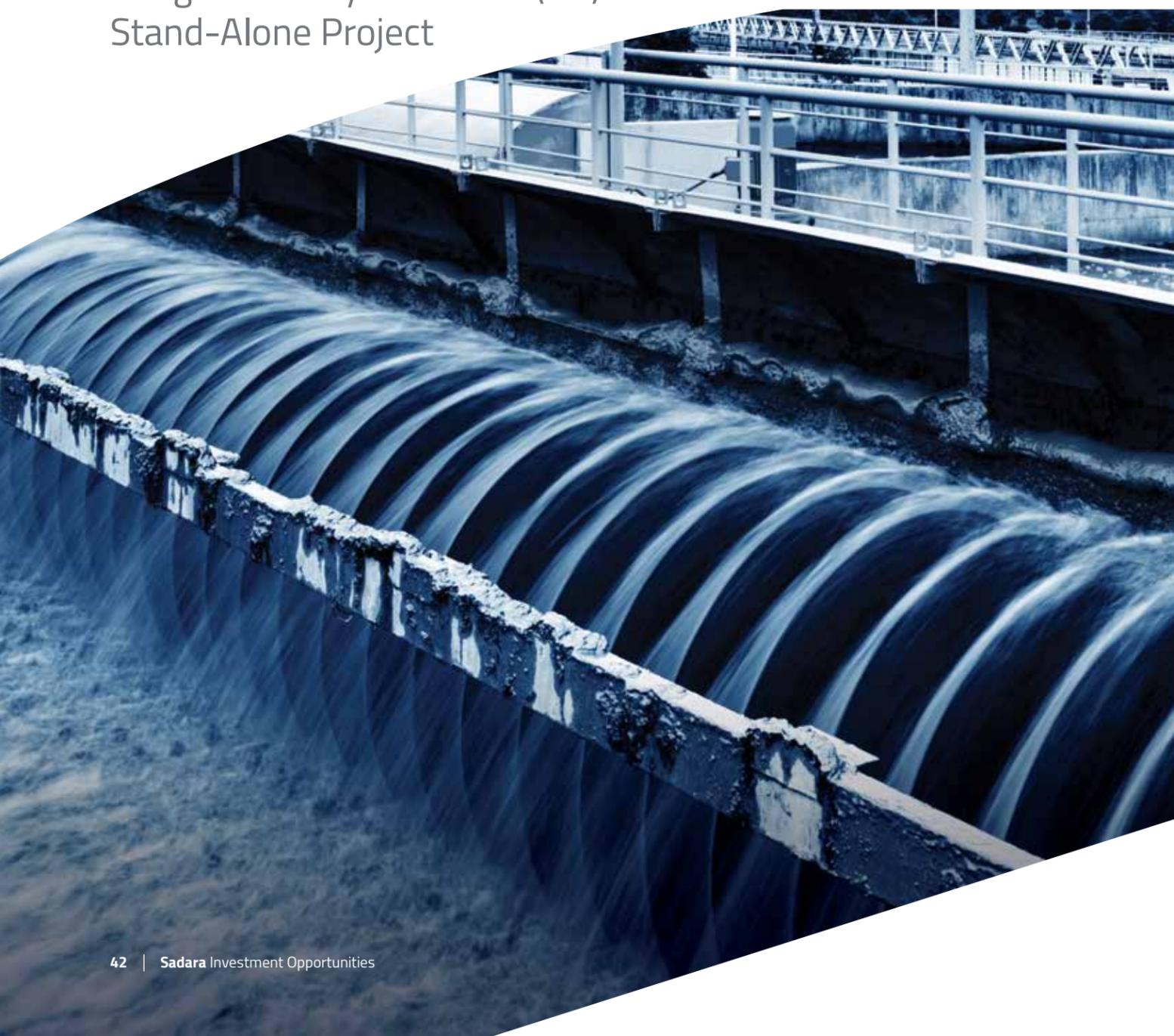
Global Growth Rate (2018-2027)

4-5% CAGR DMEA
2-3% CAGR MDEA
3-4% CAGR Polyacrylamide

	MDEA	DMEA/DMEAMA
Value US\$ Billion for the Volume Numbers	0.36 Global 0.13 ME 0.04 KSA	0.77 Global 0.06 ME 0.02 KSA

Dimethylethanolamine (DMEA) and Derivative Chemicals for Water Treatment and other applications

Integrated Ethylene Oxide (EO) – Stand-Alone Project



Opportunity Description

An investment in a plant converting EO and ammonia to chemicals for water treatment.



CAPACITY

10,000 Tons per year
DMEA/DMEAMA



TECHNOLOGY

Licensor's or JV partner is required from global providers.



KEY RAW MATERIALS

Ethylene Oxide	Sadara
Others (Ammonia, Methanol & Methyl methacrylate)	Available from multiple manufacturing sites in Saudi Arabia
KSA availability others	60-70% (formulation dependant)
EO Sadara availability	30-40% (formulation dependant)



DIRECT EMPLOYMENT

25-30



INVESTMENT RATIONALE

Import replacement.



APPLICATION USE

PAM 10-30% (formulation dependant).



PRODUCT CHEMISTRY

DMEA: Dimethyl amine and ethylene oxide
DMEAMA: Dimethylaminoethyl methacrylate.



CAPEX

\$35-75 million ±30% - OSBL 33%
\$7-10 million ISBL for a Polyacrylamide (PAM) plant (required additional process step for water treatment chemicals)



GLOBAL, MIDDLE EAST & KSA ANNUAL MARKET DEMAND

Global, Middle East & KSA Demand (2017)

255,000 Tons (Global)
20,000 Tons (Middle East)
6,000 Tons (KSA)

2 Million Tons (Global)
134,000 Tons (Middle East)
48,000 Tons (KSA)

Global Growth Rate (2018-2027)

4-5% CAGR DMEA
3-4% CAGR Polyacrylamide

Value US\$ Billion for the Volume Numbers
DMEA/DMEAMA

0.77 Global
0.06 ME
0.02 KSA

Methyldiethanolamine (MDEA) Chemical for Gas Treatment

Integrated Ethylene Oxide (EO) - Stand-Alone Project



Opportunity Description

An investment in a plant converting EO and ammonia to chemicals for gas treatment.



CAPACITY

30,000 Tons per year MDEA



TECHNOLOGY

Licensors or JV partner is required from global providers.



KEY RAW MATERIALS

Ethylene Oxide	Sadara
Others (Ammonia & Methanol)	Available from multiple manufacturing sites in Saudi Arabia
KSA availability others	60-70% (formulation dependant)
EO Sadara availability	30-40% (formulation dependant)



DIRECT EMPLOYMENT

25-30



INVESTMENT RATIONALE

Import replacement.



APPLICATION USE

MDEA 30-50% (formulation dependant).



PRODUCT CHEMISTRY

MDEA: Methyl amine and ethylene oxide.



CAPEX

\$80-120 million ±30% - OSBL 33%



GLOBAL, MIDDLE EAST & KSA ANNUAL MARKET DEMAND

Global, Middle East & KSA Demand (2017)

228,000 Tons (Global)
82,000 Tons (Middle East)
18,000 Tons (KSA)

Global Growth Rate (2018-2027)

2-3% CAGR MDEA

Value US\$ Billion for the Volume Numbers MDEA

0.36 Global
0.13 ME
0.04 KSA

B) Ethyleneamine Derivatives

Ethyleneamine Derivatives
Ethylene Oxide (EO) Integrated /
Combined Derivatives Plant



Opportunity Description

An investment in a plant converting ethyleneamines to chemicals for various markets including gas treatment and CASE. Requires market growth or large exports.



CAPACITY

30,000 Tons per year
MDEA



TECHNOLOGY

Licensor's or JV partner is required from global providers.



KEY RAW MATERIALS

Ethylene Oxide	Sadara
Ammonia	Available from multiple manufacturing sites in Saudi Arabia
KSA availability Ammonia	50-70% (formulation dependant)
EO Sadara availability	80-100% (formulation dependant)



DIRECT EMPLOYMENT

10-15



INVESTMENT RATIONALE

Differentiated product slate to local producers with import substitution.



APPLICATION USE

5-70% (formulation dependant).



PRODUCT CHEMISTRY

Amine compounds containing ethylene linkages between amine groups.



CAPEX

\$60-75 million ±30% - OSBL 33%



GLOBAL, MIDDLE EAST & KSA ANNUAL MARKET DEMAND

Global, Middle East & KSA Demand (2017)

486,000 Tons (Global)

91,000 Tons (Middle East)

3,000 Tons (KSA)

Global, Middle East & KSA Growth Rate (2018-2027)

3-4% CAGR Global

4-5% CAGR Middle East

4-5% CAGR KSA

Value US\$ Billion for the Volume Numbers

2.00 Global

0.09 Middle East

0.03 KSA

Ethyleneamine (EDA & DETA) Derivatives



Opportunity Description

An investment in a plant converting ethyleneamines to chemicals for construction and gas treatment.



CAPACITY

10,000 Tons per year MDEA



TECHNOLOGY

Licensor's or JV partner is required from global providers.



KEY RAW MATERIALS

EDA & stearic acid

EDA & formaldehyde and hydrogen cyanide, or an alkali metal cyanide

DETA & Fatty acids

KSA availability others 5-35% (imported)

KSA availability Formaldehyde 1-9% (formulation dependant)

EDA Sadara availability 70-95% (formulation dependant)

DETA Sadara availability 65-90% (formulation dependant)



PRODUCT CHEMISTRY

Amine compounds containing ethylene linkages between amine groups.



CAPEX

\$30-40 million ±30% - OSBL 33%

KEY RAW MATERIALS	DERIVATIVE	POTENTIAL LOCAL SUPPLIER
EDA & stearic acid	EBS	Sadara/ Imports
EDA & formaldehyde and hydrogen cyanide, or an alkali metal cyanide	EDTA	Sadara/KSA production/Imports
DETA & Fatty acids	Imidazolines	Sadara/ Imports



GLOBAL, MIDDLE EAST & KSA ANNUAL MARKET DEMAND

Global, Middle East & KSA Demand (2017)

486,000 Tons (Global)

9,100 Tons (Middle East)

3,000 Tons (KSA)

Global, Middle East & KSA Growth Rate (2018-2027)

3-4% CAGR Global

4-5% CAGR Middle East

4-5% CAGR KSA

Value US\$ Billion for the Volume Numbers

2.00 Global

0.09 Middle East

0.03 KSA



DIRECT EMPLOYMENT

10-15



INVESTMENT RATIONALE

Differentiated product slate to local producers with import substitution.



APPLICATION USE

5-70% (formulation dependant).

Cluster 4

Polymer Applications

Polymer moulding and extrusion for Medical, Pharmaceutical and Cosmetic disposables

Product / Target Market Overview

Medical devices cover a range of products, from simple to highly sophisticated, but they can in general be divided into disposable and non-disposable items.

In 2017, the GCC's total consumption of medical devices was about 10 000 tons, with KSA accounting for 71 percent of total GCC demand. Please note that if a cannula weighs 12g, this would be 100 million units per year. The size of the Saudi market has the biggest number of local manufacturers compared with other GCC countries.

Kuwait, UAE and Oman have similar numbers of hospital beds, so their overall consumption of medical devices is very similar; they had 8, 8 and 7 percent of total demand in 2017, respectively.

While a relatively small volume globally, it must be highlighted that the total value of the Middle East and African market for medical devices is around US\$10 billion annually.

Usage (differentiated product slate to local producers):

- Catheters: Tubing (extrusion) & Connectors (injection moulded & extruded)
- Cannulas: Tubing (extrusion) & Connectors (injection moulded & extruded)
- Laboratory Test Sample Kit: Test Tube (injection moulded), Cap (injection moulded) & Tray (injection moulded)
- Elastomer Bed Sheeting (extruded)
- Sheath / Cover / Disposable: Sheath (injection moulded)

Note:

- GCC Health Council approval required for market access.
- These disposable plastic and elastomers products are not under imminent threat of substitution.

Polymer Applications

Polymer moulding and extrusion for Medical, Pharmaceutical and Cosmetic disposables



Opportunity Description

An investment in a plant converting plastic granules and additives to disposable medical devices for the GCC market.



CAPACITY

1,000 to **1,250** Tons per year



TECHNOLOGY

Licensor's or JV partner is required from global providers.



KEY RAW MATERIALS

LLDPE, LDPE, HDPE Elastomer's & PU Polypropylene	Multiple manufacturing sites in Saudi Arabia
KSA other polymer availability	97-100% (formulation dependant)
Sadara polymer availability	97-100% (formulation dependant)



DIRECT EMPLOYMENT

30-50



INVESTMENT RATIONALE

Differentiated product slate to local producers with import substitution.



APPLICATION USE

100%



PRODUCT CHEMISTRY

Products typically produced from polyethylene, polypropylene or more specialised elastomer's by extrusion or injection moulding.



CAPEX

\$25-30 million ±30%-OSBL 16%



GLOBAL, MIDDLE EAST & KSA ANNUAL MARKET DEMAND

Global, Middle East & KSA Demand (2017)

2.6 Million Tons (Global)
26,000 Tons (Middle East)
7,200 Tons (KSA)

Global, Middle East & KSA Growth Rate (2018-2027)

3-4% CAGR Global
11-15% CAGR Middle East
4-5% CAGR KSA

Value US\$ Billion for the Volume Numbers

340 Global
6.6 Middle East
0.9 KSA

Sadara Chemical Company

Enabling the Growth of Saudi Arabia's Downstream Manufacturing Industry



Sadara Business Development Team

Sadara Chemical Company
P.O. Box 11811
Jubail 31961
Kingdom of Saudi Arabia
Email: plaschem@sadara.com

www.sadara.com

